Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

EMPIRE BUILDING SEPTEMBER, 1945 PITTSBURGH, PA.

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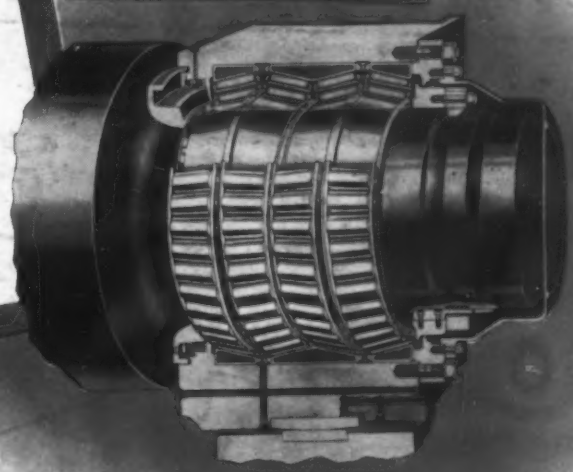
DETROIT

NO OTHER BEARING OFFERS All THESE ADVANTAGES FOR ROLL NECKS



Before selecting roll neck bearings for new or existing mills, it will pay you to compare the Timken "Balanced Proportion" Roller Bearing with any other bearings you may have in mind, on the basis of the following advantages:

Superior operating smoothness of the Timken Roller Bearing.

4 Maximum thrust capacity without the use of external supports such as thrust rings or plates.

7 Consistently lower maintenance cost; the Timken Roll Neck Bearing is entirely self-contained; does not depend on a complicated system of pipes and pumps.

High mill separating force capacity in relation to diameter of roll neck.

5 Simplicity and economy of lubrication.

8 Make possible instant restarting of all types of mills at any time without release of roll pressure and consequent loss of production.

Low roll neck stress and deflection in relation to roll separating force capacity.

6 Greater ease of handling on and off the roll necks; no delicate or complicated parts to handle.

9 Proved ability to roll greater tonnages than ever have been rolled by any other roll neck bearings and at the lowest bearing cost per ton ever recorded.

The Timken "Balanced Proportion" Roll Neck Roller Bearing is the culmination of 25 years of constant engineering development and experience.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN

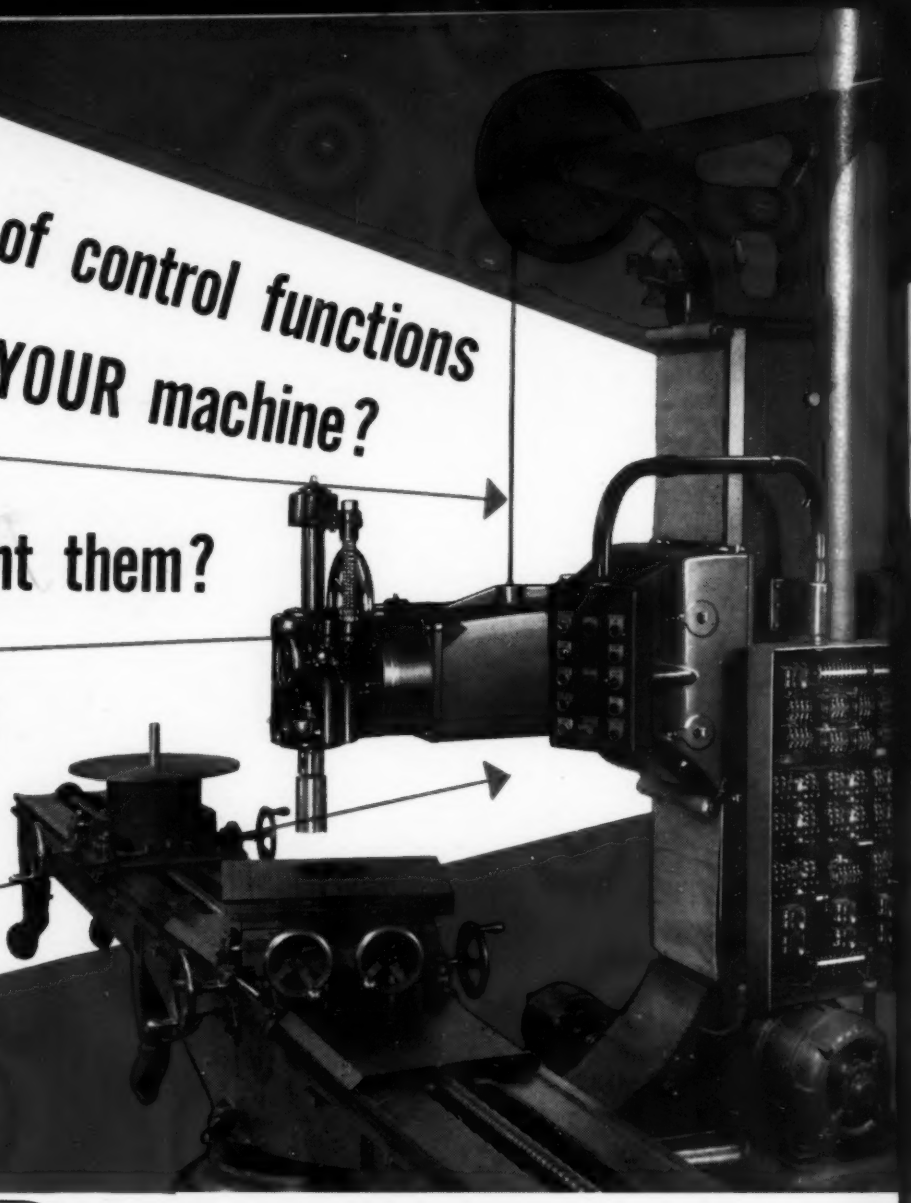
TRADE-MARK REG. U. S. PAT. OFF.

ROLL NECK BEARINGS

What combination of control functions do you want in YOUR machine?

Where do you want them?

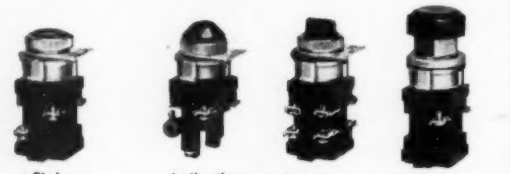
How do you want them grouped?



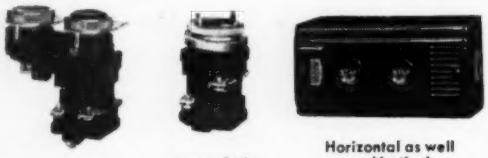
Oliver Universal Pattern Milling Machine. Adaptation of Custom Built Control Station Utilizing C-H Unitized Elements.

UNITIZED CONSTRUCTION

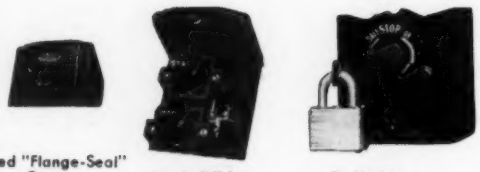
makes it possible to deliver to you just the pushbutton you need . . . any mounting . . . any operator . . . any circuit combination.



Plain Pushbutton — Indicating Light — Selector Switch — Mushroom Head for easy operation



Maintained Contact — Latch-Safe Switch — Horizontal as well as Vertical Mounting



Fitted "Flange-Seal" Covers — Ample Wiring Space despite small size — Padlocking Arrangement Available

All units available in oil-tight construction to protect against coolants and oils. Maintenance trouble with resultant costly production tie-ups can now be avoided.

YOU WILL FIND THE ANSWERS TO THESE QUESTIONS AND MANY MORE IN THE CUTLER-HAMMER LINE OF *UNITIZED* PUSHBUTTON STATIONS

The Cutler-Hammer Line of Heavy Duty Pushbutton Stations (NEMA Type 1) for surface mounting and (NEMA Type 1B) for flush mounting provides the answer to many machine design control problems. The surface mounting enclosures accommodate from 1 to 8 Cutler-Hammer new unitized pushbuttons; the flush mounting constructions accommodate from 1 to 3 C-H unitized pushbuttons. The line provides the widest selection of functions and combinations available today and permits these stations to be "tailored" to your exact needs.

Among the many advanced engineering features are the following: any circuit combination for each pushbutton; wide variety of operating means; big buttons for gloved-hand operation; projecting shatterproof color caps for 180° visibility; fitted "flange-seal" covers for extra sturdy and tight enclosure; rugged yet light weight construction; ample internal free space for easy wiring despite small size; no sharp corners or edges; excellent appearance; optional padlocking feature. Stations may be mounted horizontally or vertically. Write for further details today. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wis. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

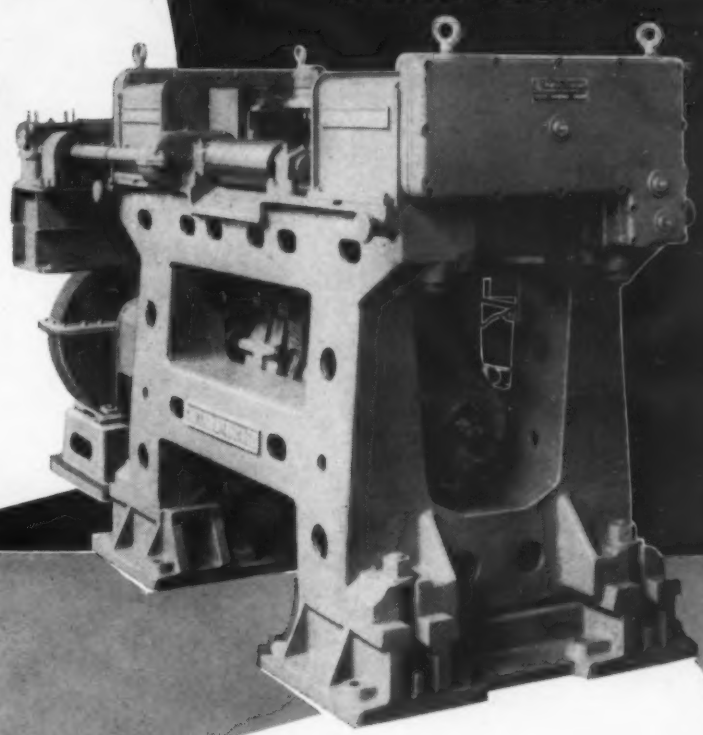
Engineering excellence finds its greatest reward in the respect and confidence of those it serves

CUTLER-HAMMER
MOTOR CONTROL
C-H

EDGING MILLS

by Aetna-Standard

18" Vertical Edging Mill



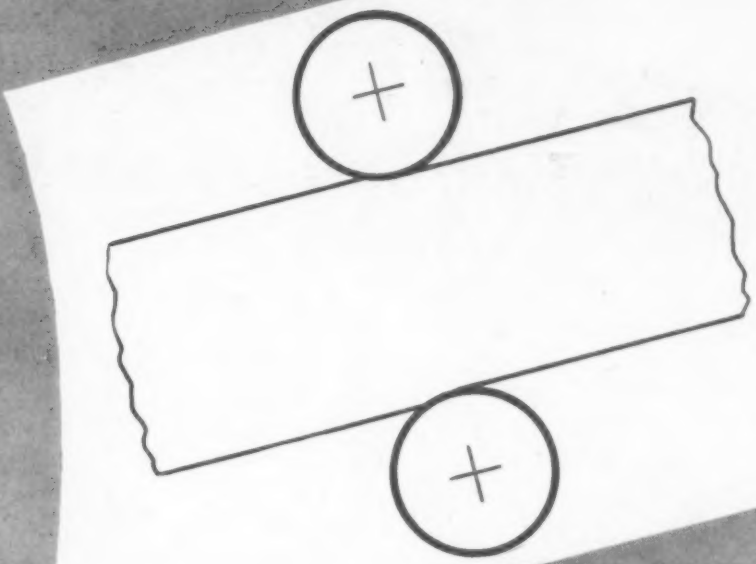
These two vertical edging mills serve as scale breakers as well as edgers.

The 38" mill handles slabs from 3 to 8½ inches thick by 20 to 66 inches wide. The 18" mill processes slabs from 2 to 6 inches thick and 2 to 24 inches wide.

Both mills have the many design and engineering features which Aetna-Standard builds into other equipment for processing flat, rolled, and tubular products.

Aetna-Standard also builds complete rolling mills, furnace charging and discharging tables, furnace pushers, structural mill tilting tables, mill run-out tables, and similar equipment.

Ask Aetna-Standard for recommendations on your mill equipment requirements.

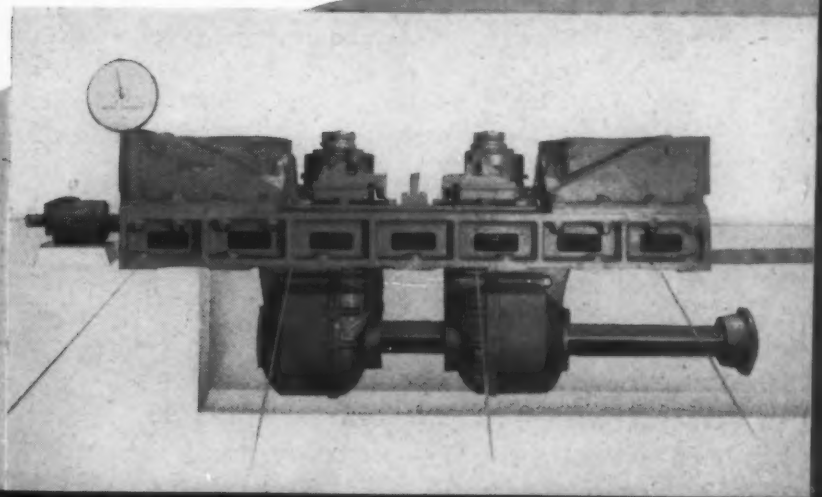


THE AETNA-STANDARD ENGINEERING COMPANY

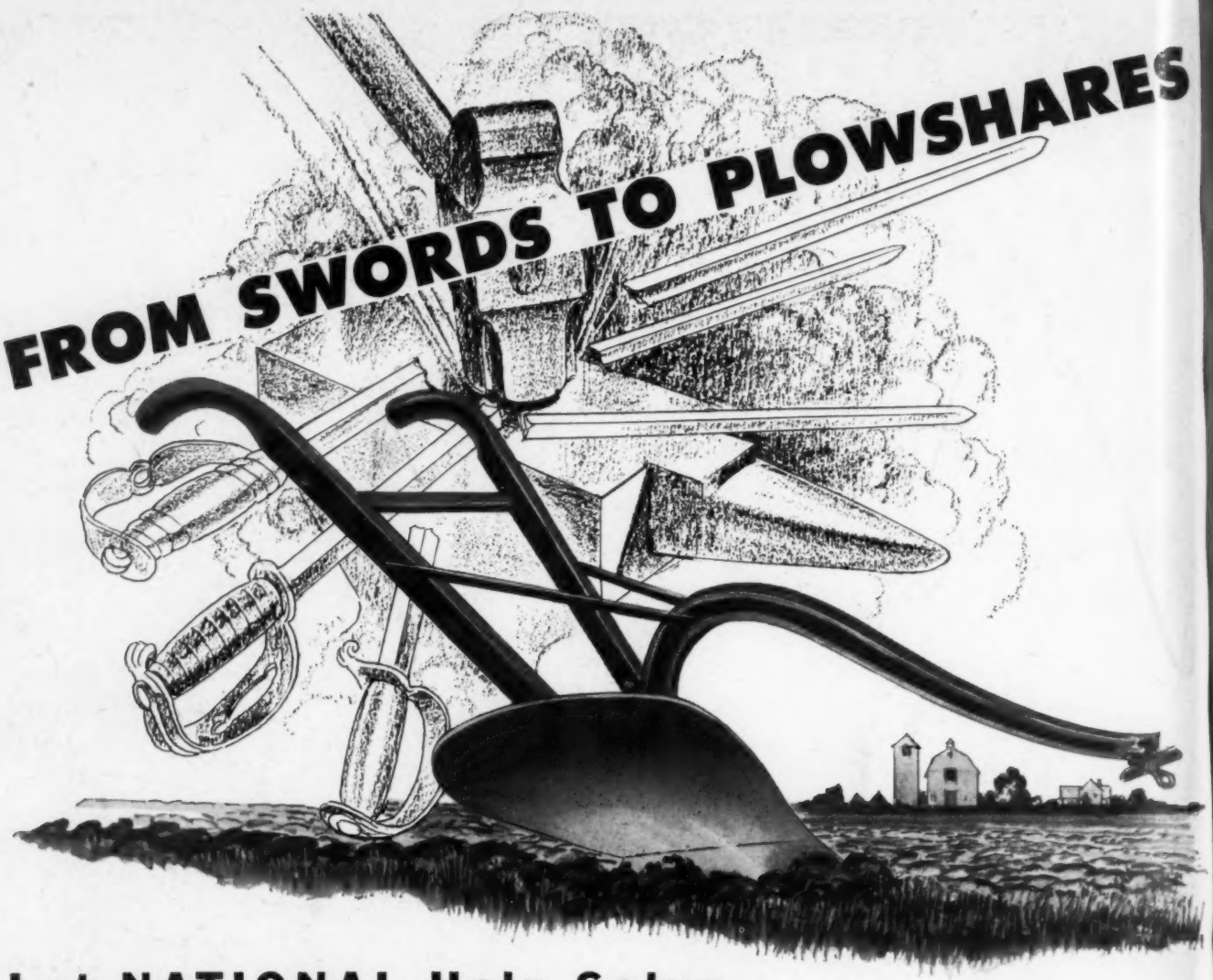
YOUNGSTOWN, OHIO

ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED
THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED
TORONTO, ONTARIO, CANADA

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries.



38" Vertical Edging Mill is powered by a 1000 h. p., 600 r. p. m. motor and has a slab rolling speed of approximately 350' per minute.

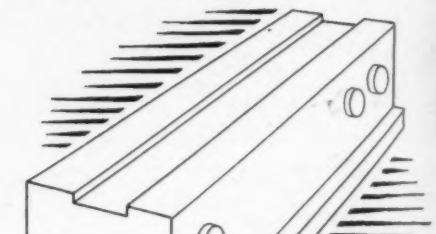


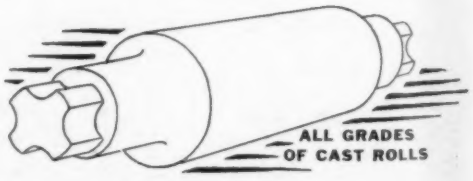
Let NATIONAL Help Solve Your Conversion Problems

There is no better time than now, when you are making plans for your post-war products, to consult National. For National has the men, machines, and metallurgical "know-how" to intelligently and speedily solve most any problem that involves the application of rolls or the manufacture of heavy iron and steel castings.

We, at National, are accepting the challenge of a new era through design and metallurgical research that is unhampered by the restraining influences of out-moded techniques.

Those engaged in metal forming or metal fabrication, who see the need for a new approach to the problems ahead, are invited to submit the facts to National for analysis.





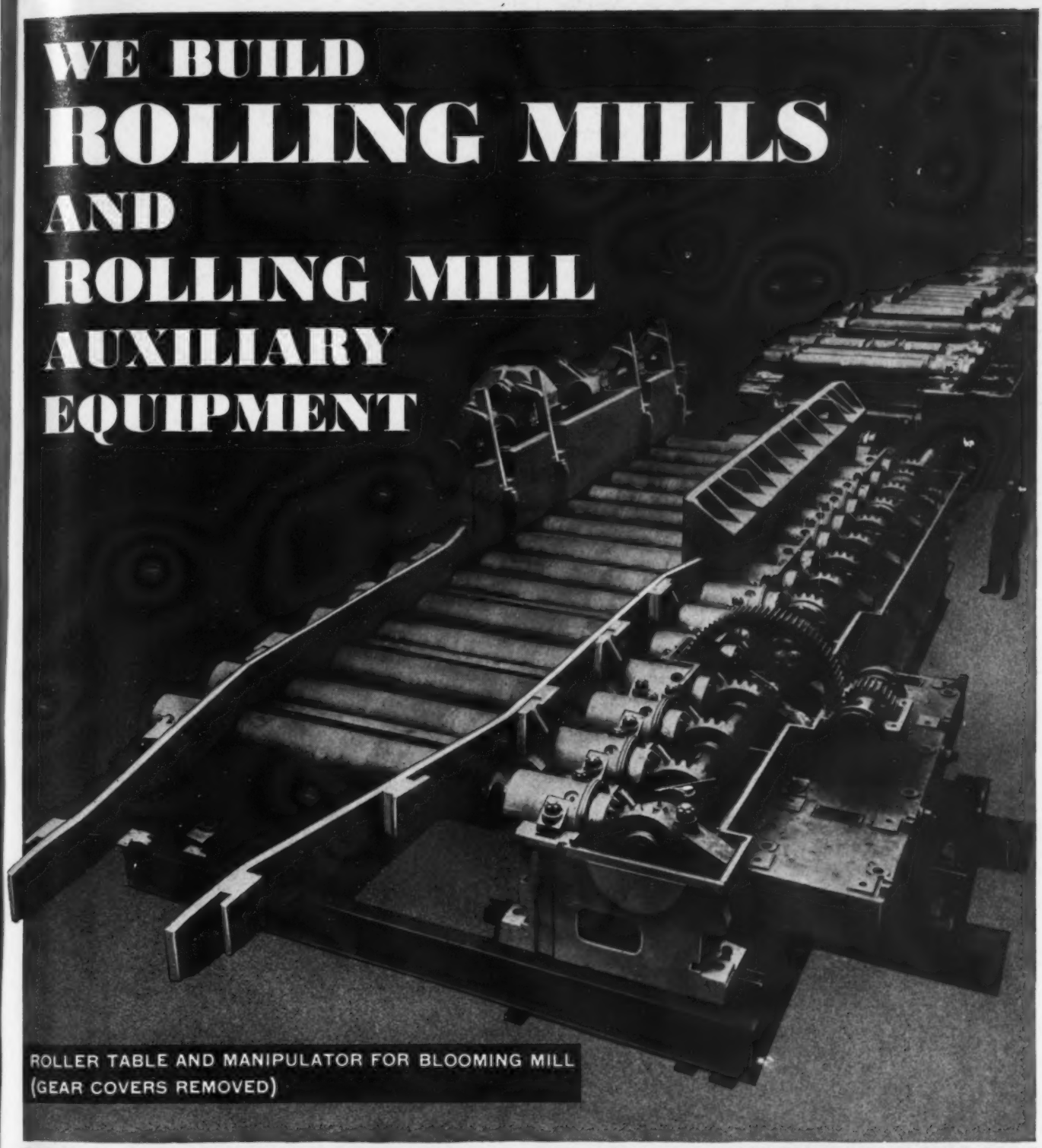
THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

Manufacturers of: ALL GRADES OF CAST ROLLS • IRON & ALLOY IRON STEEL & ALLOY STEEL • HEAVY IRON & STEEL CASTINGS • ROLLING MILL EQUIPMENT

ARMY E NAVY

WE BUILD ROLLING MILLS AND ROLLING MILL AUXILIARY EQUIPMENT



ROLLER TABLE AND MANIPULATOR FOR BLOOMING MILL
(GEAR COVERS REMOVED)

HYDROPRESS · INC.

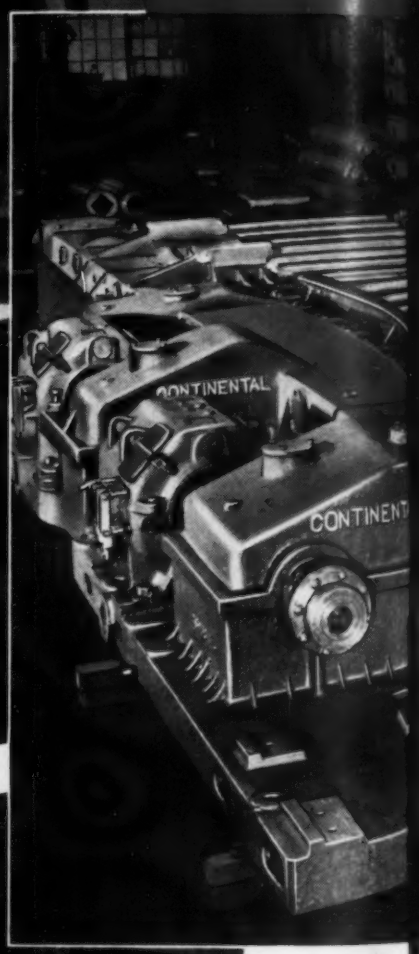
ENGINEERS CONTRACTORS

HYDRAULIC PRESSES · ROLLING MILLS
STRETCHERS · PUMPS · ACCUMULATORS

570 LEXINGTON AVENUE · NEW YORK · N. Y.

TABLES DESIGNED

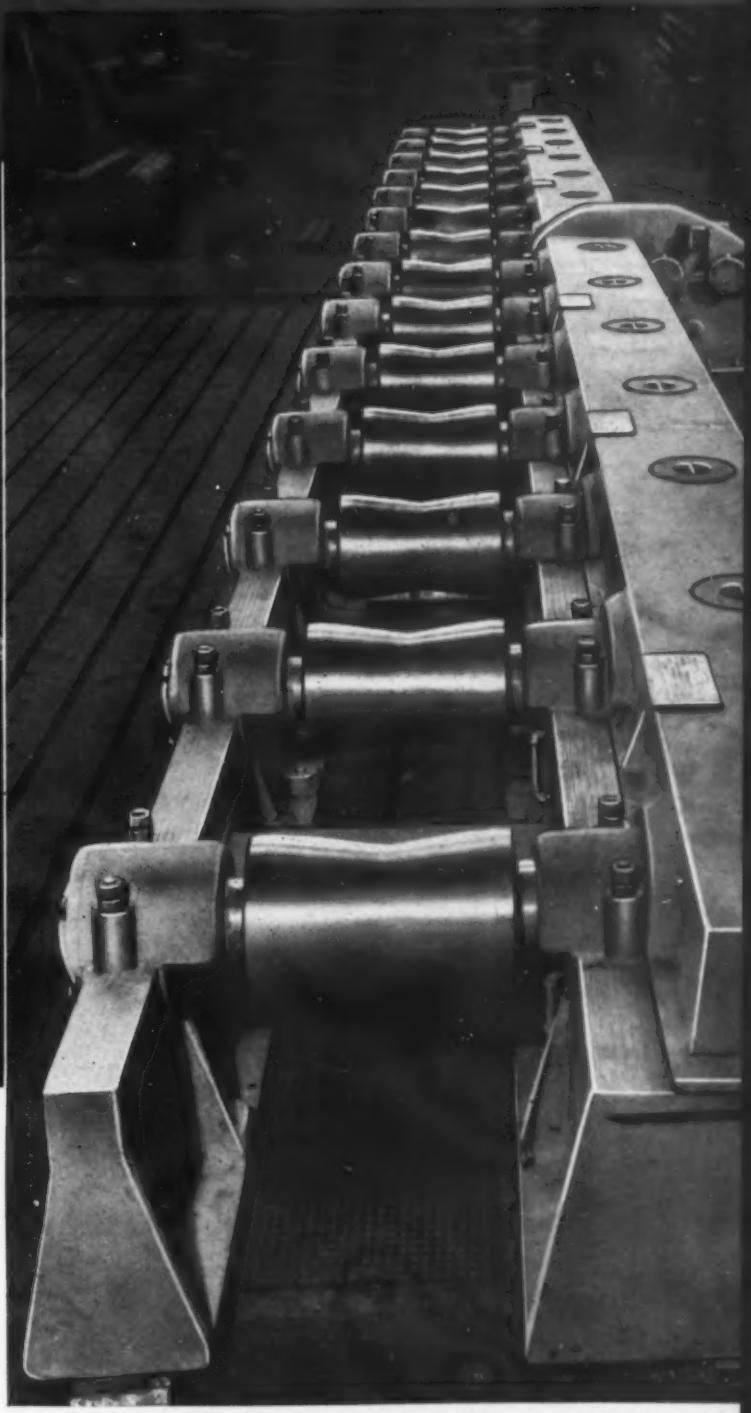
CONTINENTAL BAR MILL TABLE



CONTINENTAL PLATE MILL TABLE

NEND BUILT BY *Continental*

CONTINENTAL BLOOMING MILL TABLE



CONTINENTAL TUBE MILL TABLE

CONTINENTAL TABLES

esigned to suit your specific requirements. hese Tables are built for all types of ills and for all varieties of rolled products.

CONTINENTAL

FOUNDRY & MACHINE COMPANY

CHICAGO • PITTSBURGH

Chicago Works	Pittsburgh Works	Wheeling Works	Warwood Works
East Chicago, Ind.	Carnegie, Pa.	Wheeling, W. Va.	Wheeling, W. Va.

UNITED

4-High Reversing Cold Mills

READILY ADJUSTABLE FOR ROLLING VARIABLE TONNAGES OF HIGH OR LOW CARBON STEEL . . . STAINLESS . . . ALLOY . . . BRASS . . . BRONZE . . . ALUMINUM . . . MAGNESIUM IN A WIDE RANGE OF GAUGES AND WIDTHS

From a production and operational cost standpoint, the versatility and extreme flexibility of UNITED 4-HIGH REVERSING COLD MILLS recommend them especially for rolling tonnages which may not be handled conveniently or economically on other types of mills. We have built them with work rolls as small as 2 inches in diameter with 4-inch faces and as large as 24 inches in diameter with 112-inch faces for many users both here and abroad.

United engineers can offer you designs duplicating existing installations or revisions of these to meet your special requirements.

UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON

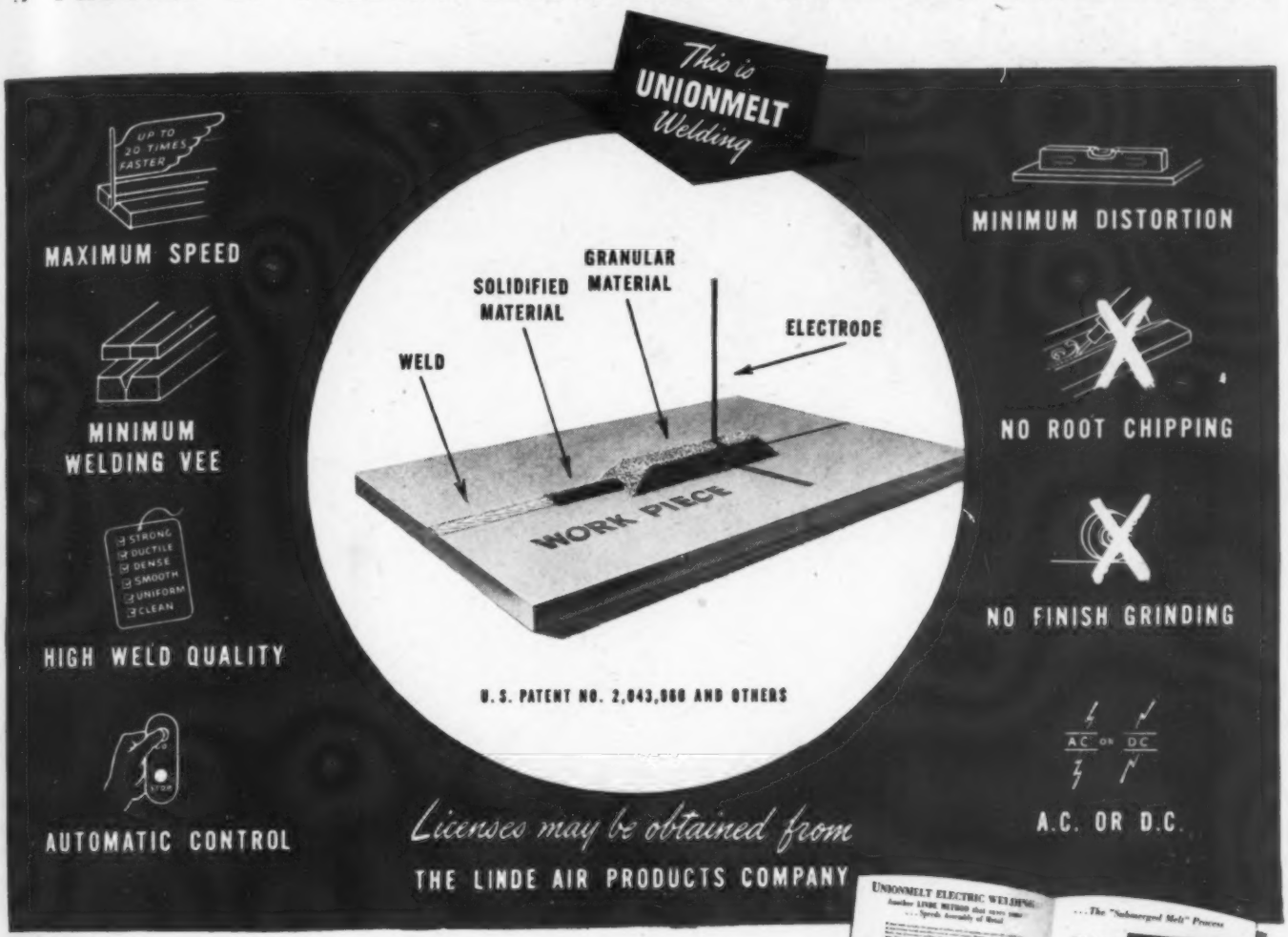
Subsidiary: Adamson United Company, Akron, Ohio

Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment

These are the advantages of Automatic UNIONMELT Electric Welding

A PROCESS OF WELDING ELECTRICALLY BENEATH A MINERAL MELT



Hundreds of manufacturers are now benefiting by the advantages of UNIONMELT Welding. It gives them top quality welds at speeds that are greater than with any other similarly applicable process.

If your work includes the joining of carbon steel, of stainless, and other alloy steels, or of non-ferrous metals and alloys such as nickel, copper, Monel, and Everdur, it is quite likely that UNIONMELT Welding can speed production, raise quality, and lower your costs.

Anyone who wishes to use this patented invention may do so under our standard license agreement. License fees are low and are based upon extent of use. Complete engineering assistance is available to licensees.

For additional information send for the folder *"Report No. 6 on the Use of Linde Methods in Mass Production"*—or ask a Linde representative to help you determine where you can use the UNIONMELT process advantageously.

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. Offices in Other Principal Cities

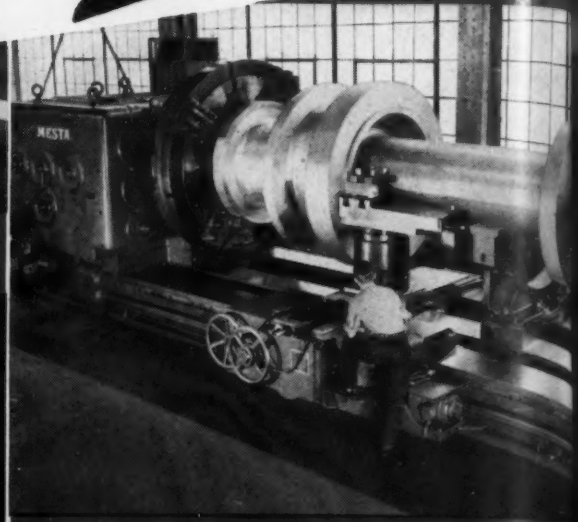
In Canada: Dominion Oxygen Company, Limited, Toronto

The word "Unionmelt" is a registered trade-mark of The Linde Air Products Company.

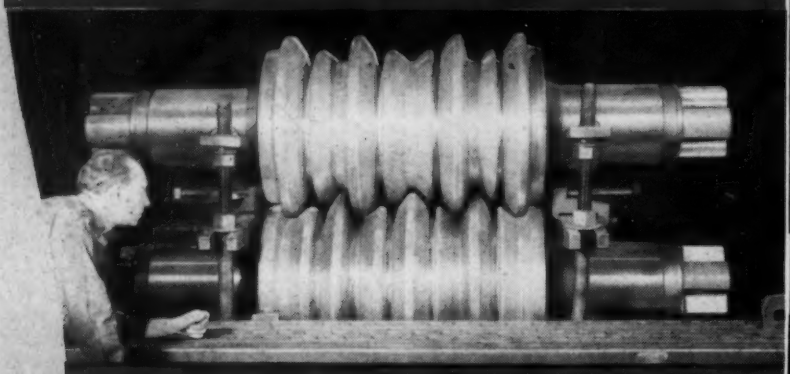
★ BUY UNITED STATES WAR BONDS AND STAMPS ★

Built by

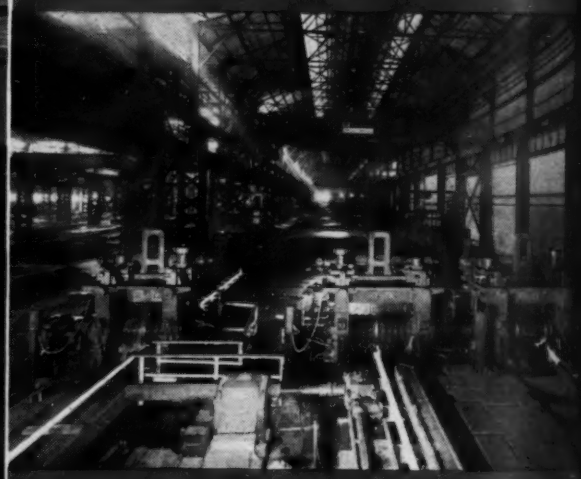
Mesta 29" Structural Mill Showing Travelling Fitting Table



Massive Rotor Shafts for Turbine Driven Generators Installed at The World's Largest Dams



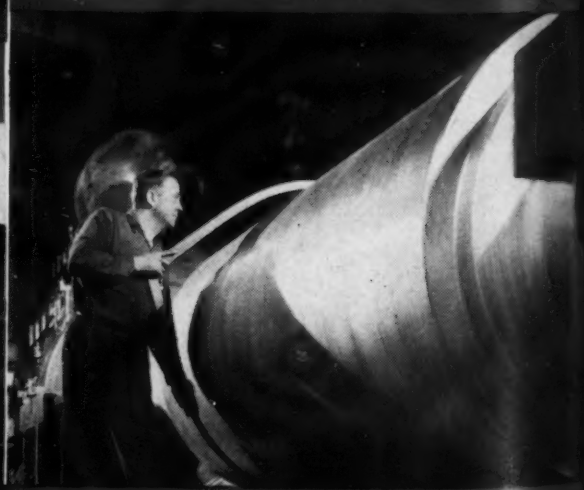
Mesta Grate Merchant Mill Rolls for Small Beams and Channels



Mesta 32" Two-High Bar Mill, Showing Transfers and Manipulators

Forging 16" Gun Tube at Mesta on a 6,000 Ton Hydraulic Press

Mesta 38" Blooming Mill

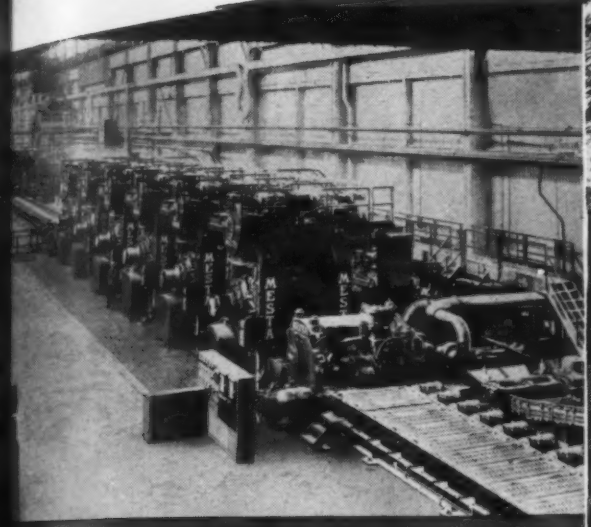


Turning Mesta Special Alloy Cast Steel Backing-Up Roll

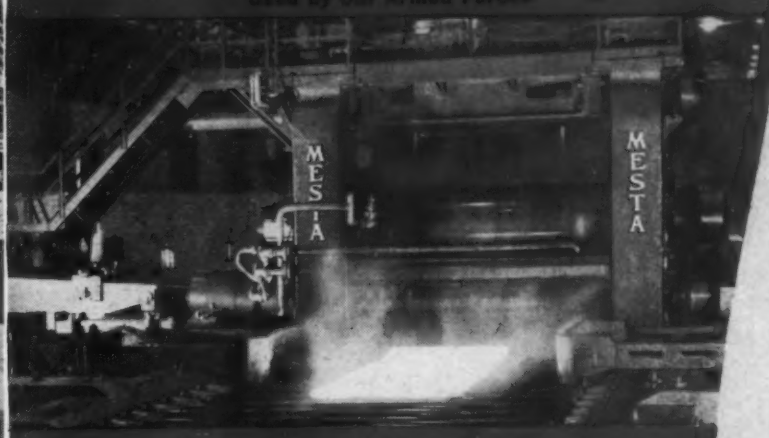
MESTA MACHINE CO.

MESTA

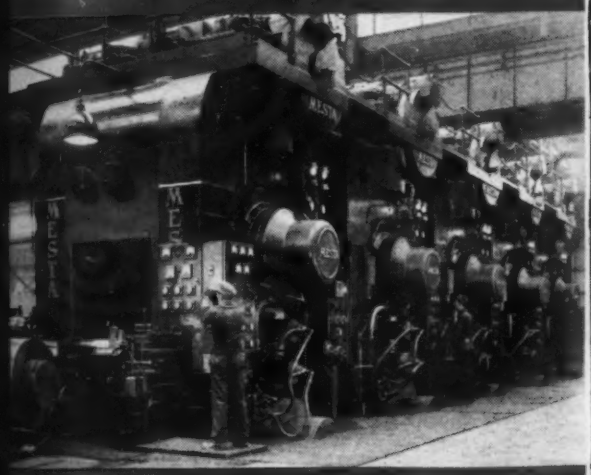
Mesta Produces in a Special Division Great Quantities of Heavy Guns Including the Largest Regularly Used by Our Armed Forces



86" Four-High Ten Stand Continuous Hot Strip Mill Designed and Built By Mesta



160" Four-High Reversing Plate Mill Designed and Built by Mesta



Mesta 42" Five Stand Tandem Cold Mill for Rolling Tin Plate Gauges

32" Mesta Patented Pickling Machines for Pickling Drop Forgings

132" Four-High Continuous Plate Mill Designed and Built by Mesta

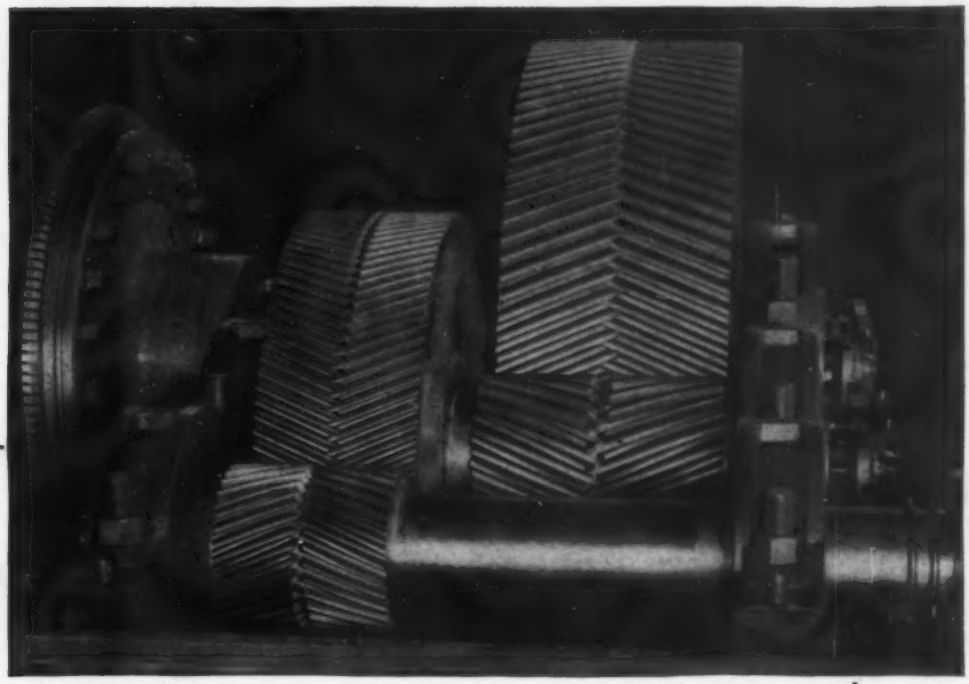
Mesta Hydraulic Up-Cut Bloom Shear

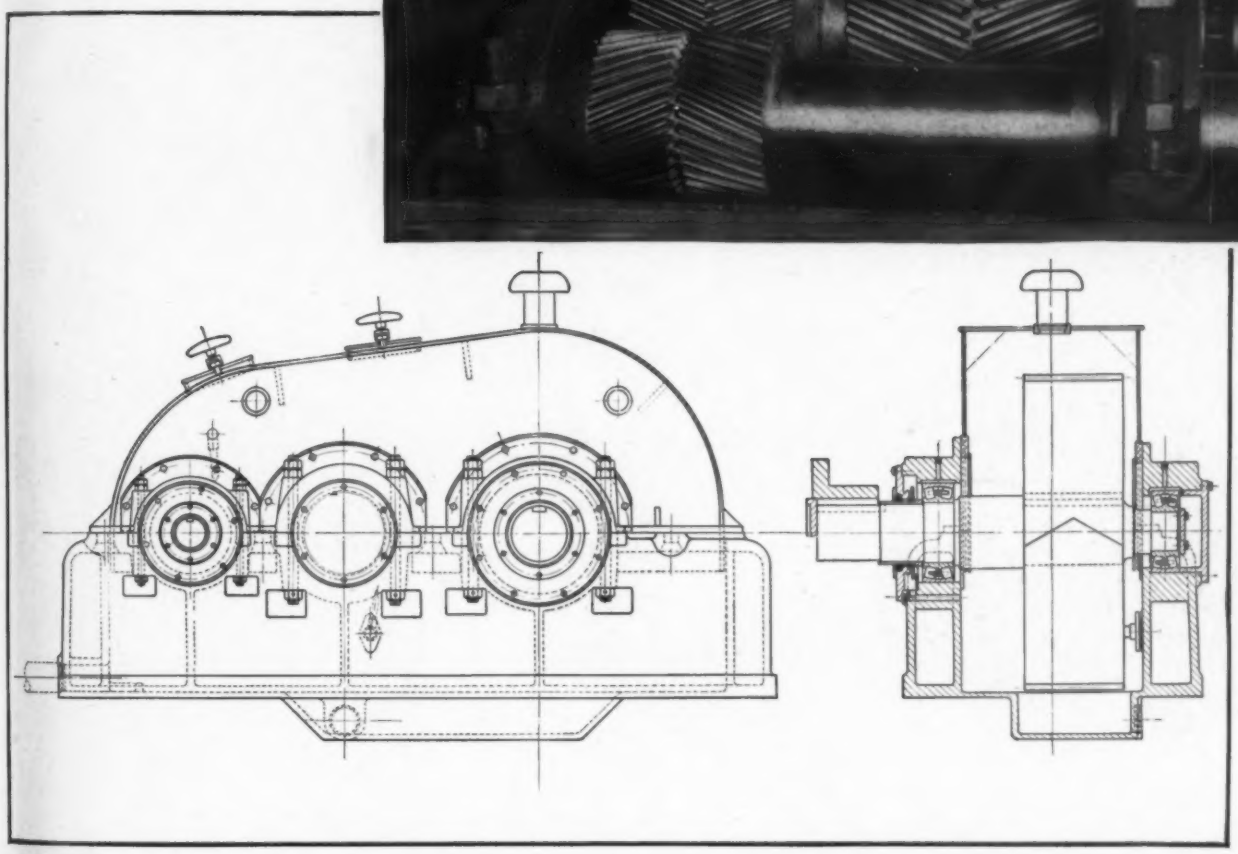
PITTSBURGH, PA.

English Representative: International Construction Co., 56 Kingsway, London, W. C. 2, England

THE RIGHT BEARINGS

For Gear Drives!





Driving mills 24 hours a day, 365 days a year, is a job that calls for dependability, self-alignment, high load-carrying capacity and long life in bearings. That's why SKF Spherical Roller Bearings are used on this Gear Drive. They're on the job the clock around. Their self-aligning properties eliminate overloads caused by misalignment. Their full capacity is always available for useful work. And they roll smoothly for years with inner races tight on the shafts and outer races sliding in the gear case. Only occasional lubrication is required, and fussy adjustments are never needed. All of which can be summed up in one word: PLUS-PERFORMANCE. SKF Industries, Inc., Front Street and Erie Avenue, Philadelphia 34, Pa. 5874

SKF

ROLLER BEARINGS

It's the Men Who Make the Rolls

Roll making is more of an art than it is a mechanical process—an art that demands years of training and experience.

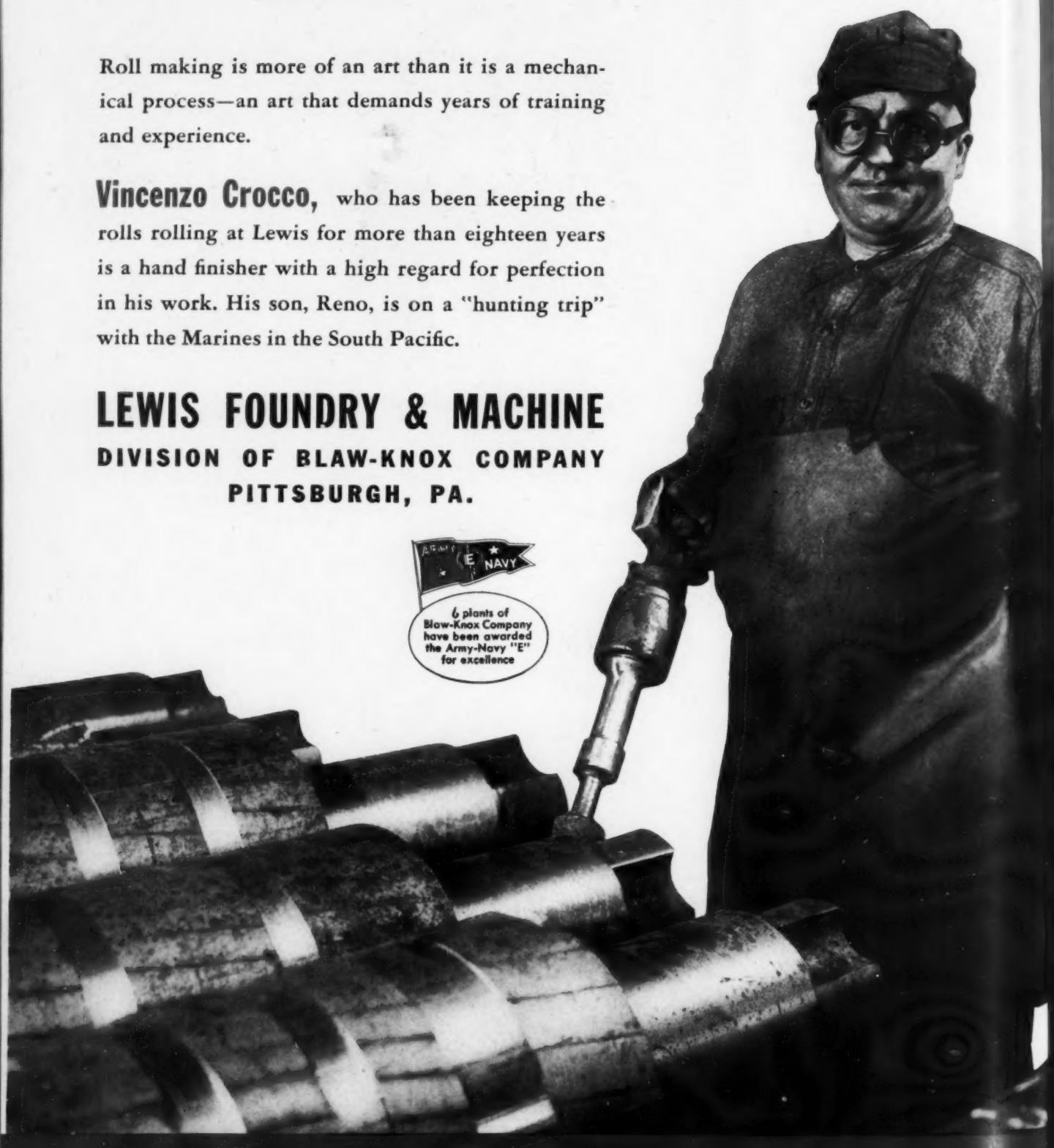
Vincenzo Crocco, who has been keeping the rolls rolling at Lewis for more than eighteen years is a hand finisher with a high regard for perfection in his work. His son, Reno, is on a "hunting trip" with the Marines in the South Pacific.

LEWIS FOUNDRY & MACHINE

DIVISION OF BLAW-KNOX COMPANY

PITTSBURGH, PA.

6 plants of Blaw-Knox Company have been awarded the Army-Navy "E" for excellence



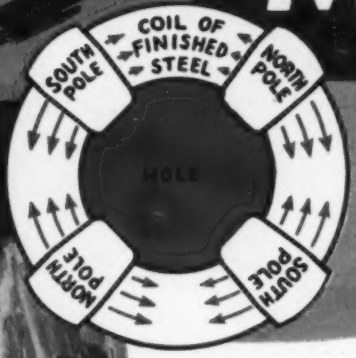
LEWIS ROLLS

YOUR *Conversion Plans* SHOULD INCLUDE

MODERN COIL-HANDLING MAGNETS

The E C & M TYPE CSM MAGNET

... FOR COLD STRIP COILS



●EC&M Type CSM Magnet (No. 6) lifting two coils weighing 56,600 pounds —*the World's Biggest Lift of Coiled Steel.*

●This EC&M No. 2 Type CSM Magnet is shown in the above illustration, placing a coil on the annealing bottom.

Designed to *lift the coil,* not the hole. No mass of metal over the hole and no concentric pole shoes limiting the flux path in the coil. Instead, this modern magnet combines compactness and small weight with lifting ability distributed *within the coil itself.*

Its advantages for *finished* coil handling are:

1. Magnetic flux concentrated in the coil to be lifted.
2. *Balanced load*—less danger of injury to bottom of coil when depositing coil.
3. Magnet is smaller than other coil handling magnets, weighs less.
4. Magnet does not hide the view of the crane operator.
5. Magnet fits the coil with minimum overhang resulting in increased storage capacity.
6. Less damage to edges of coil because of wide pole shoes which span coil-turns and because weight of magnet is less and is evenly distributed over coil surface.

For handling Raw Coils, other EC&M Magnets are available. Information on request.

E C & M

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET CLEVELAND 4, OHIO

Use Wagner Protected Motors for Jobs Involving Dust, Fumes, and Moisture

WAGNER DRIPPROOF MOTORS are so designed and constructed that drops of liquid or solid particles falling on the motor at any angle not greater than 15 degrees from the vertical cannot enter the motor either directly or by striking and running on a horizontal or inwardly inclined surface.

WAGNER EXPLOSION-PROOF MOTORS have been approved by the Underwriters Laboratories for Class I Group D hazardous locations, "where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, or natural gas are manufactured, used or handled."

WAGNER SPLASH-PROOF MOTORS are built to operate dependably in locations where they are subject to splashing water, oil, or other liquids. They are widely used in exposed outdoor locations, and are completely self-protected against ice, sleet, snow, and rain.

WAGNER TOTALLY-ENCLOSED FAN-COOLED MOTORS are designed to operate under severe and adverse conditions in locations where dust, dirt, abrasives, steel chips, filings, acid fumes, and other harmful elements may damage the windings and bearings.

WAGNER TOTALLY-ENCLOSED NON-VENTILATED MOTORS may be installed in the locations just described and are built instead of totally-enclosed fan-cooled motors in the smaller ratings because they are less expensive. In the larger ratings they are used where the draft produced by the fan-cooled motor is objectionable.

These motors are protected to do their jobs under severe operating conditions

Do you use motors "in hazardous locations", or perhaps where splashing liquids are present, or where the air contains dust, dirt, acid fumes, etc.? No matter how severe the operating conditions, Wagner has the right motor that is adequately protected against such hazards. Check the advantages gained from using these five types of protected Wagner motors. Then let a Wagner motor authority help you decide which type will solve your motor problem.

Write for Bulletin MU-185 or consult the nearest Wagner Branch...

ATLANTA 3 • BALTIMORE 18 • BOSTON 15 • BUFFALO 8 • CHICAGO 16 • CINCINNATI 10
CLEVELAND 15 • DALLAS 1 • DENVER 2 • DETROIT 2 • HOUSTON 2 • INDIANAPOLIS 4 • KANSAS CITY 8 • LOS ANGELES 15 • MEMPHIS 3 • MILWAUKEE 2 • MINNEAPOLIS 4 • NEW YORK 7
OMAHA 2 • PHILADELPHIA 8 • PITTSBURGH 13 • PORTLAND 9 • ST. LOUIS 3 • SALT LAKE CITY 1
SAN FRANCISCO 3 • SEATTLE 4 • SYRACUSE 2 • TULSA 3 • WASHINGTON 5

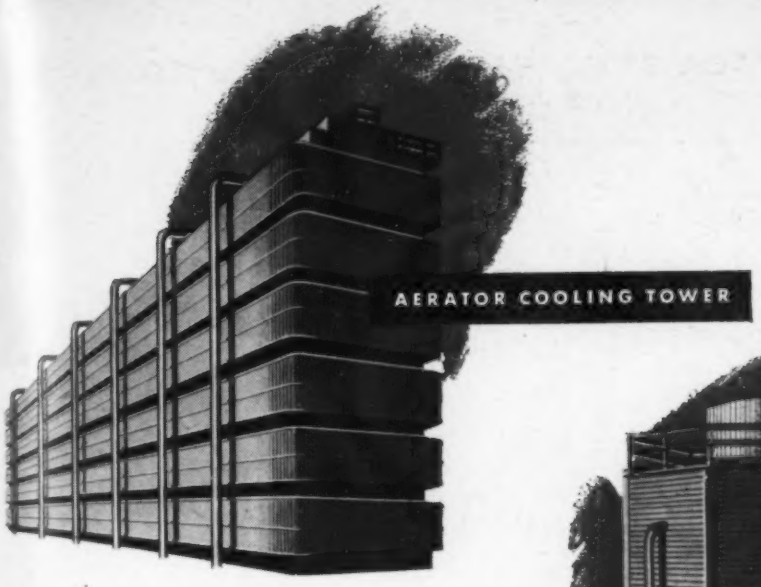
MOTORS are but one of several WAGNER PRODUCTS serving industry.

Other WAGNER PRODUCTS:
AIR BRAKES
•
BRAKE LINING
•
HYDRAULIC BRAKES
•
INDUSTRIAL BRAKES
•
INDUSTRIAL BRAKE CONTROLS
•
NoRoL
•
TACHOGRAPH
(Recording Speedometer)
•
TRANSFORMERS

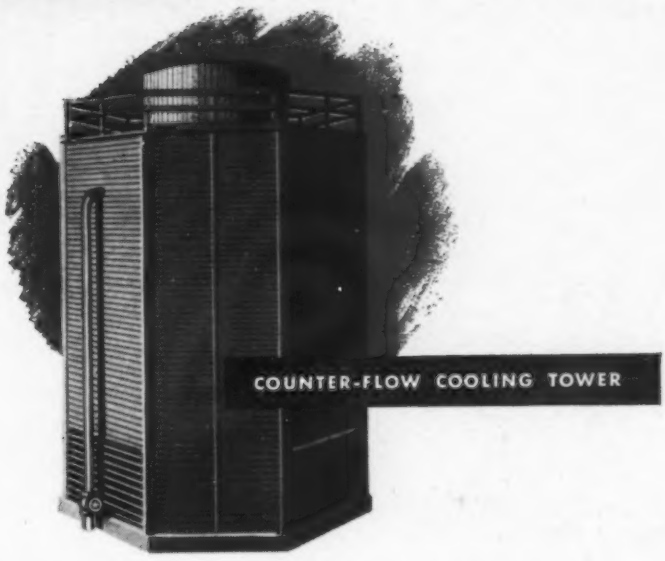
M45-16

Wagner Electric Corporation

ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
In Canada: Wagner Electric at Leaside, Ontario
ELECTRICAL AND AUTOMOTIVE PRODUCTS



AERATOR COOLING TOWER



COUNTER-FLOW COOLING TOWER

WHAT IS YOUR COOLING PROBLEM?

FIN-FAN COOLING UNIT

FLUOR doesn't try to fit just one type of Cooling Unit to all cooling requirements. There isn't any cure-all. Years of field experience on all kinds of cooling problems proves that three basic types are necessary to meet widely different conditions... and Fluor builds all three.

1. The FLUOR atmospheric type *Aerator* Cooling Tower for installations where ground space is not a consideration..... and where prevailing wind conditions are suitable. 2. The FLUOR mechanical draft type *Counter-Flow* Cooling Tower for installation where ground space is limited and a more constant cold water temperature is required.

3. The FLUOR *Fin-Fan* Cooling Unit for installation where water is scarce or expensive and bottom temperatures desired are not approximately atmospheric temperature. FLUOR recommendations are based upon the correct unit for the specific conditions and requirements, backed by extensive field tests and broad engineering experience on all three types of Cooling Units.

BE SURE WITH FLUOR SINCE 1890

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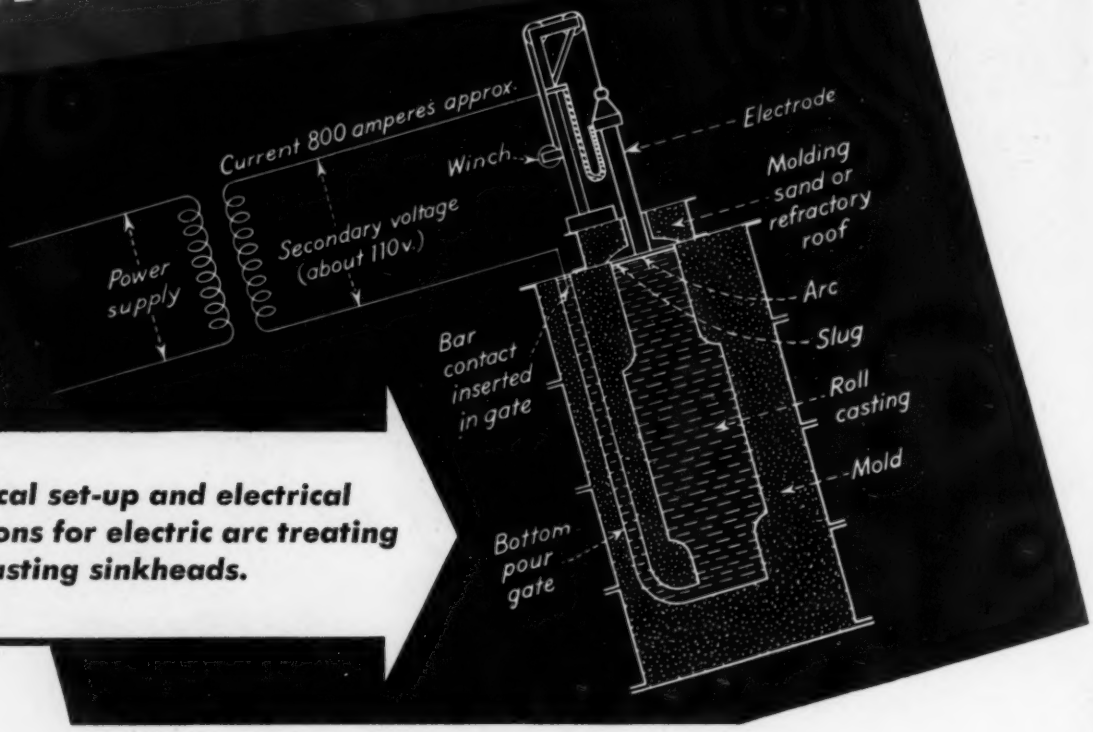
No. 11 of a Series: "Looking at the FIVE ESSENTIAL things you never see in ELECTRODES."

TOP CROP CUT TO 5% WITH ELECTRIC ARC HOT TOPPING



Mechanical set-up and electrical connections for electric arc treating of roll casting sinkheads.

SEVERAL years ago National Carbon Company began a series of experiments with electric arc heating of steel ingot hot tops and the sinkheads of large steel castings. The results of these experiments have been confirmed in commercial practice by several steel plants, which report the process offers economy and an increase in production without upping producing capacity.

One stainless steel plant, where operating practice was exceptionally good, normally obtained a top crop of 8½%. Electric arc hot topping reduced the crop to 5% . . . at a saving of several dollars per ton over the cost of the hot topping operations.

At another plant producing large roll castings, 694 tons of metal were treated. Castings averaged 27.8 tons. Total saving was 111.4 tons, an average of 4.5 tons per casting. The cost: less than $1 per ton of metal treated.

Hot topping apparatus is inexpensive. Electrode consumption is only one-half pound per ton of metal treated.

Our experimental work with hot topping is part of what we call "customer service"—one of the five essential things you never see in "National" carbon and "Acheson" graphite electrodes. The others: selection of raw materials, manufacturing experience, manufacturing control, and continuing research. We invite you to write our nearest office about these reasons for the superior performance of "National" and "Acheson" electrodes.

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ACHESON GRAPHITE

The words "National" and "Acheson" and the "National" and "Acheson" Seals are registered trade-marks of National Carbon Company, Inc.

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Unit of Union Carbide and Carbon Corporation
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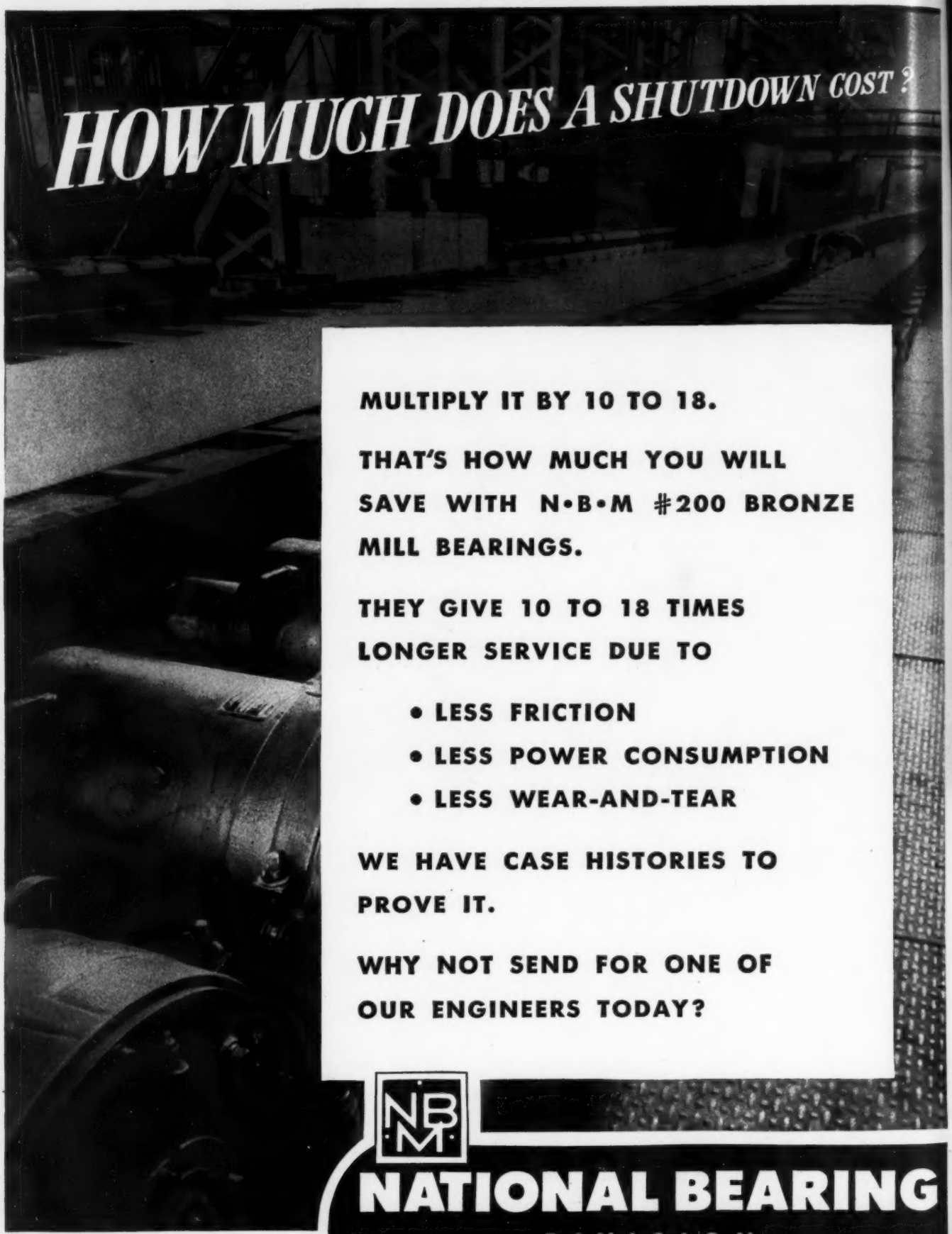
Makers of the rolls with the red scabbers



MULTIPLY IT BY 10 TO 18.

THAT'S HOW MUCH YOU WILL SAVE WITH N•B•M #200 BRONZE MILL BEARINGS.

THEY GIVE 10 TO 18 TIMES LONGER SERVICE DUE TO

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- LESS POWER CONSUMPTION
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WE HAVE CASE HISTORIES TO PROVE IT.

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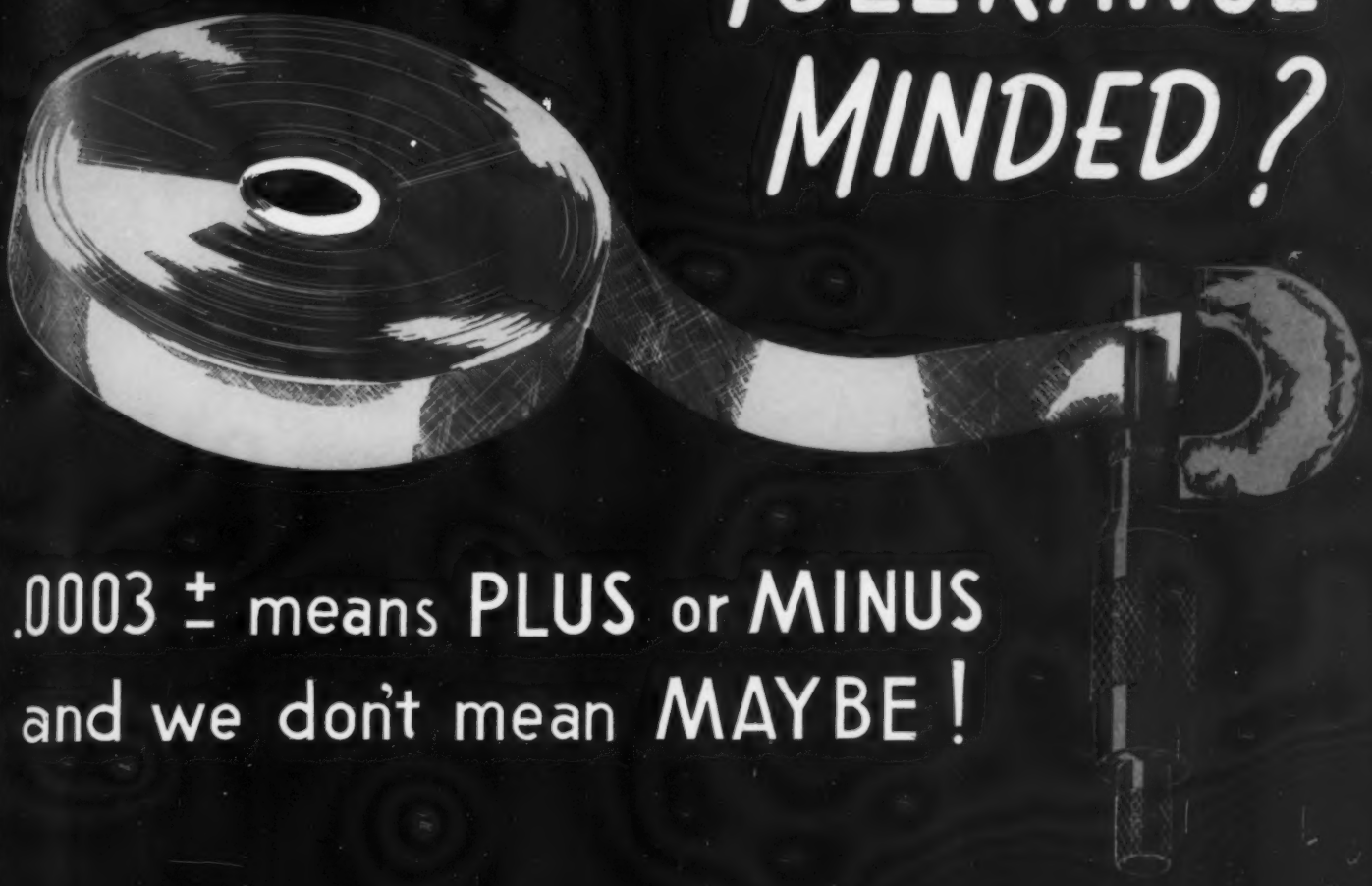
TOLERANCE MINDED?



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and we don't mean MAYBE!

YES-we are tolerance minded

and justly so • for we know that space limitation is an important factor to be considered when layer insulation is selected for building up structures of armature - field and current control windings.

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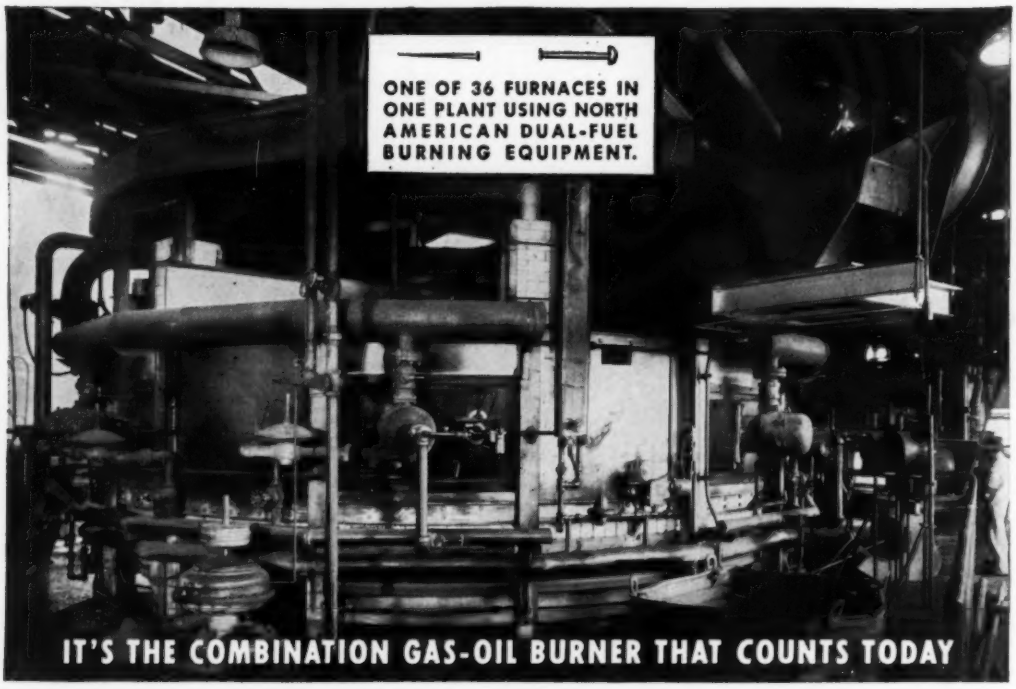
IS PREPARED *for* THIS WINTER'S COMPETITION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The TRANSPORTER in an exceptionally wide variety of applications, demonstrates its flexibility, its ability to work in small areas, its ease of handling, and its advantages in moving greater tonnages in shortest time with safety. Unnecessary handling is eliminated.

The TRANSPORTER saves man hours, and costs in moving materials from receiving to storage, through production and to shipping.

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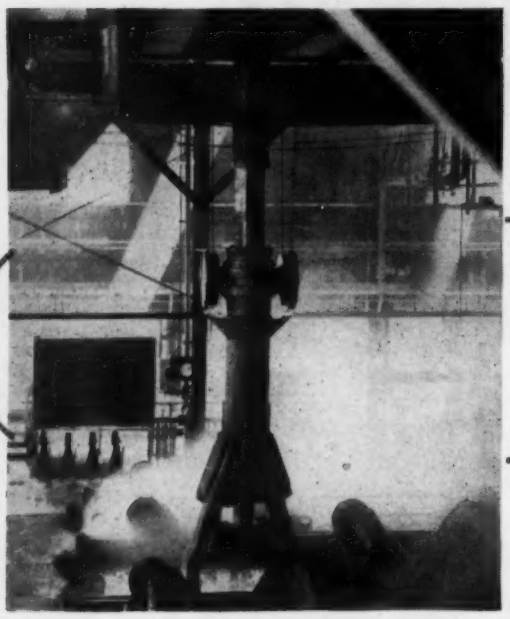

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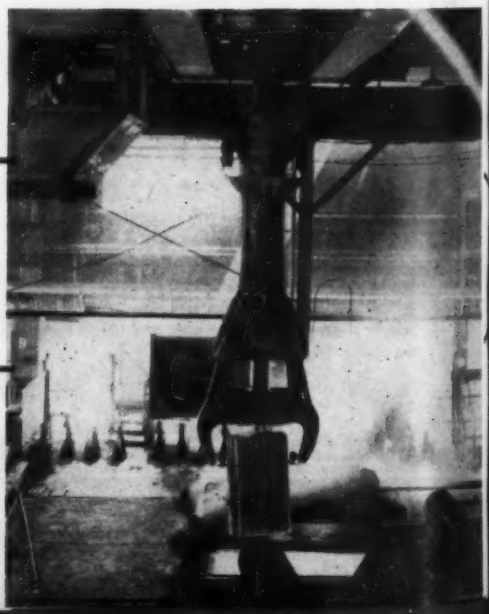

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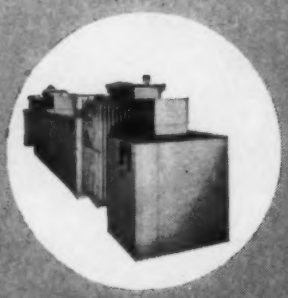
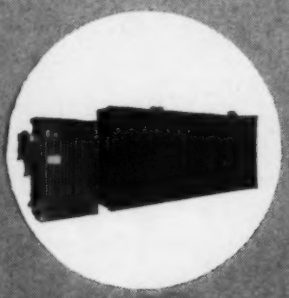
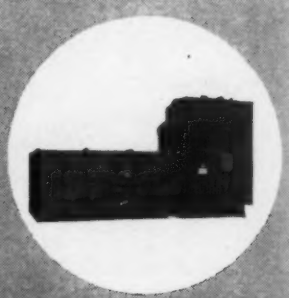


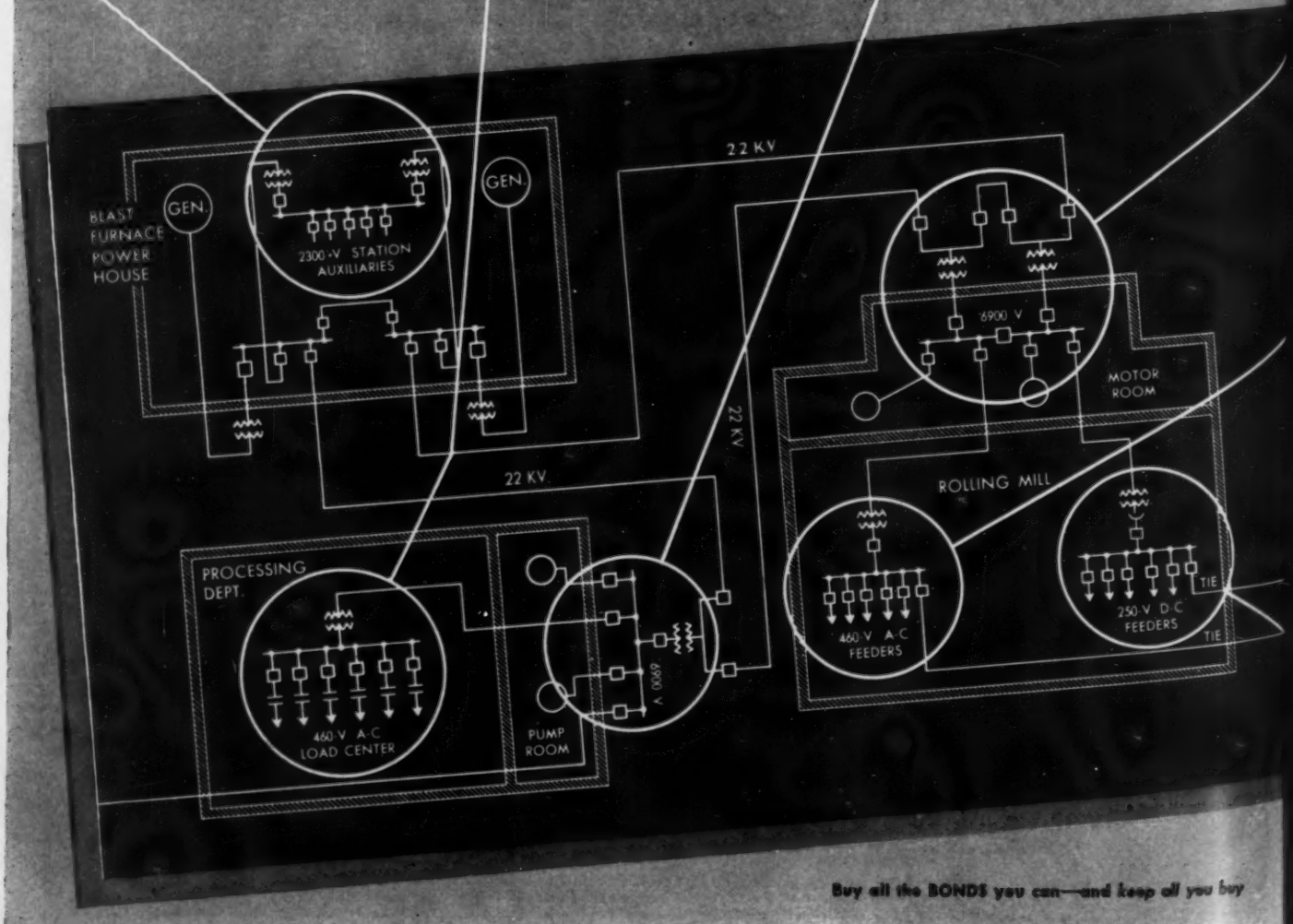
MASTER UNIT SUBSTATION—double-ended type for use where continuity is especially important.



CONTROL-CENTER UNIT—for centralized control of low-voltage motor circuits served directly from high-voltage source.



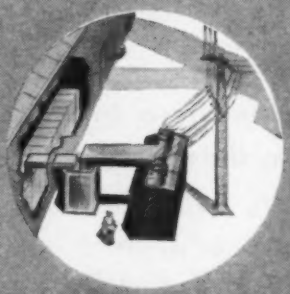
MASTER UNIT SUBSTATION—outdoor type. Vertical-lift, interchangeable breakers are easy to remove and inspect.



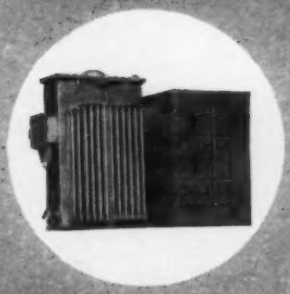
Buy all the BONDS you can—and keep all you buy

OF POWER ARTERIES

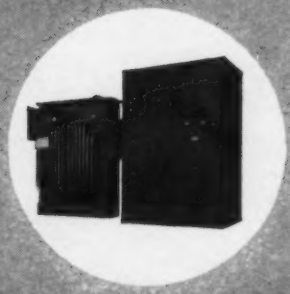
THESE STANDARD LOAD-CENTER UNITS KEEP STEEL-MILL POWER DISTRIBUTION IN STEP WITH CHANGING NEEDS



UNIT SUBSTATION "POWER ISLAND"—Type FH breakers protect 22-kv loop; make industrial high-voltage distribution practical and economical.



INDOOR UNIT SUBSTATION—compact "go-anywhere" unit, with draw-out air breakers for use at load centers (100 to 2000 kva).



D-C UNIT SUBSTATION—for converting high-voltage a-c to low-voltage d-c at utilization point.

Your distribution equipment need not be a limiting factor in power-supply flexibility—tending to "freeze" your operations to a fixed and obsolete layout.

Expansion, rearrangement, and modernization are all simplified for plants which have standard G-E unit substations and switchgear throughout their load-center power-distribution systems.

Like building blocks, the metal-clad switchgear, Pyranol* or dry-type transformers, and other elements that make up G-E unit substations can be assembled in hundreds of standard arrangements. Because of this versatility, they make it easy to meet the various combinations of requirements in your power-system plans. They make it easy to distribute power at a copper-saving and cost-saving *high* voltage, and then step it down to effective utilization voltage at the center of each load area. They facilitate the use of circuit arrangements which safeguard continuity: network, primary-selective, and secondary-selective systems. They permit highly economical cable runs where both high voltage and low voltage are being utilized in the same area.

Less Manpower Needed for Changes

Units are easily relocated, and no rewiring except the circuit connections is required. Additions to a load-center system can be made step by step to handle new loads without upsetting the system plan, or without interrupting production. Installed costs are fully predictable.

G-E application engineers can supply the facts and figures you want on the use of "packaged" power-distribution equipment for steel mills of any size or type. Just call your local G-E representative. *General Electric Co., Schenectady 5, N. Y.*

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LOAD-CENTER POWER DISTRIBUTION SYSTEMS

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WHEN MEN WERE PLENTIFUL AND LABOR CHEAP

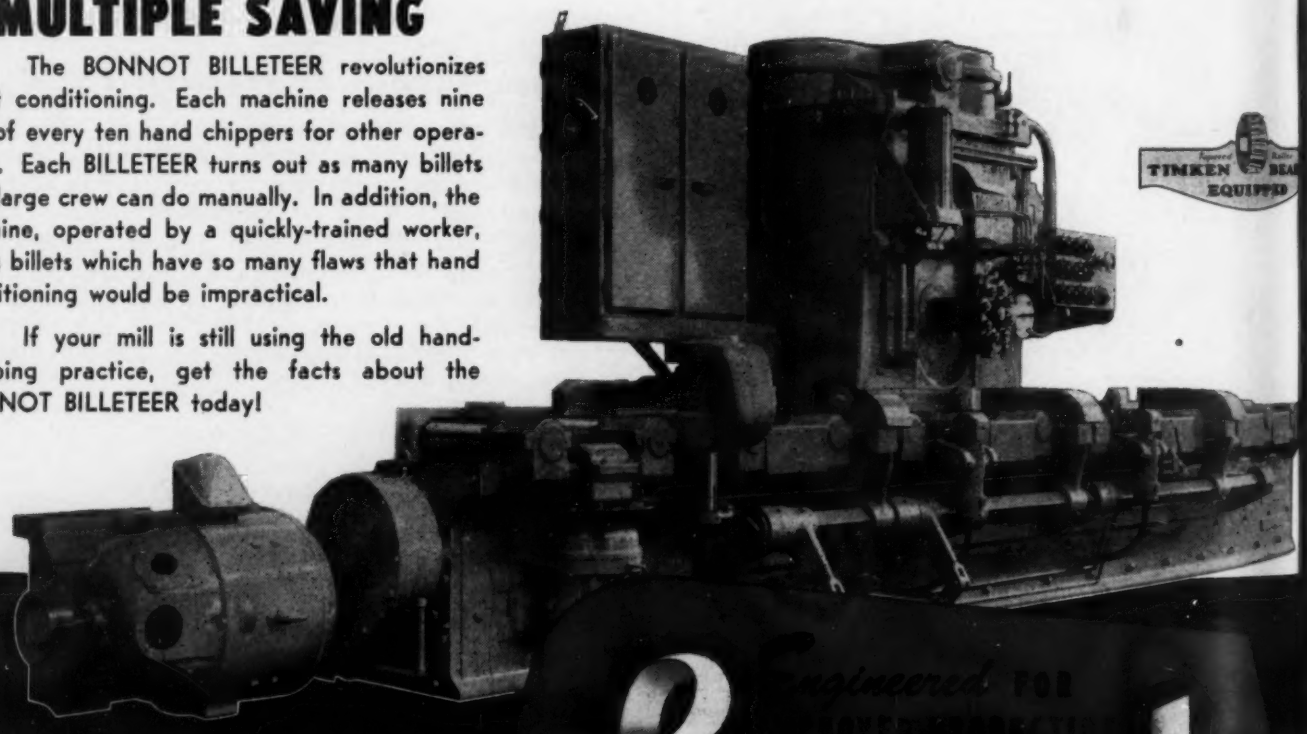
It was logical to dig out coal with hand picks. In these days of tremendous tonnage demands and keen competition, following this slow old method would be pure folly. Instead, big power drills and modern methods turn out tons of coal in a hurry.

The history of steel billet conditioning is the same story! Hand chipping is rapidly becoming a thing of the past, because men are no longer plentiful, labor is not cheap and competition is extremely keen.

MULTIPLE SAVING

The BONNOT BILLETEER revolutionizes billet conditioning. Each machine releases nine out of every ten hand chippers for other operations. Each BILLETEER turns out as many billets as a large crew can do manually. In addition, the machine, operated by a quickly-trained worker, saves billets which have so many flaws that hand conditioning would be impractical.

If your mill is still using the old hand-chipping practice, get the facts about the BONNOT BILLETEER today!



MECHANIZE YOUR BILLET CONDITIONING NOW. PREPARE FOR TOMORROW'S INTENSIFIED COMPETITION.

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BUILDERS OF **THE BILLETEER**

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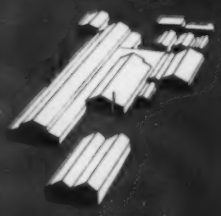

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Cold Strip Reels
Cone Worm Drives
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The *united* resources and abilities of these two internationally known companies, both leaders in their respective fields for over 30 years, offer unusual advantages to industries interested in the development of new processes and equipment for present or postwar expansion.

We invite you to consult us while your plans are still in the blueprint stage.

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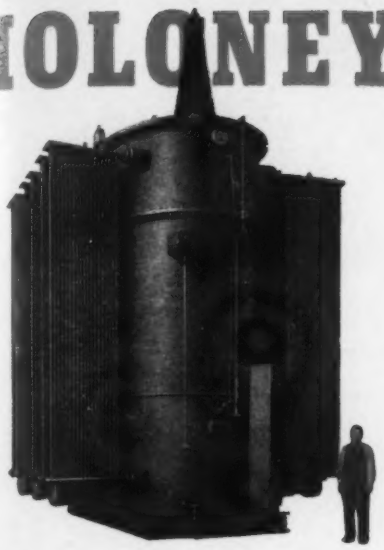
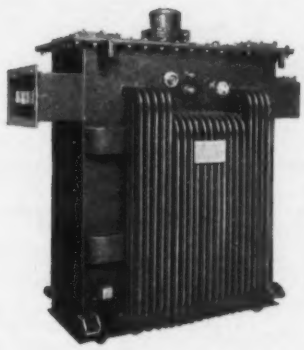
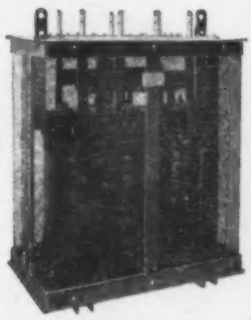
MOLONEY TRANSFORMERS



Moloney Power Transformer. Transformer pictured above is rated 25,000 Kva, 161,000Y to 13,200 volts. These transformers can be supplied in any capacity or voltage desired.



Moloney Askarel (non-inflammable liquid cooled) Transformer. For indoor installation at load centers without the use of fire-proof vaults. Available in all Kva and voltage ratings.



Moloney Air-Cooled Transformer with Class B insulation. For indoor installation at load centers without the use of fire-proof vaults. Available in voltages up to 13,800 volts and in capacities of 150 Kva and larger.

One of these MOLONEY transformers will meet your requirements . . .

Moloney manufactures transformers for all types of installations. If transformers of standard design do not fill your needs, our experienced engineering staff can design transformers which will exactly fit your requirements.

Disconnect switches, oil-fused cutouts, terminal boxes with potheads, forced-air-cooling, secondary air circuit breakers and many other features can be supplied on Moloney transformers.

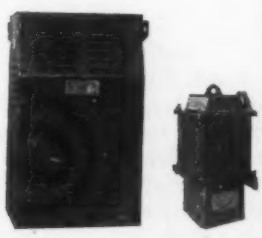
Quick shipment can be effected whether the transformers are of standard or special design. Your inquiries will be given prompt attention.

MOLONEY ELECTRIC COMPANY

ST. LOUIS, U. S. A.

Moloney Conventional Distribution Transformer, oil-cooled, for outdoor pole or platform mounting. Sizes 1½ Kva to 500 Kva. Voltages up to 66,000 volts. Illustration typical of sizes 75 and 100 Kva, 7200 to 120/240 volts.

Moloney Completely Self-Protected Transformer, oil-cooled, equipped with built-in lightning and secondary overload protection. Sizes 1½ to 50 Kva. Voltages 2400 to 13,800 volts. Illustration typical of sizes 1½ to 25 Kva, 7200 to 120/240 volts.



Moloney General Purpose Air-Cooled Transformers with Class A insulation. For industrial use to serve lighting and small power loads. Left illustration typical of sizes 15 to 50 Kva. Right illustration typical of sizes 1 Kva to 10 Kva. Voltages 600, 480 or 240 to 120/240 volts.

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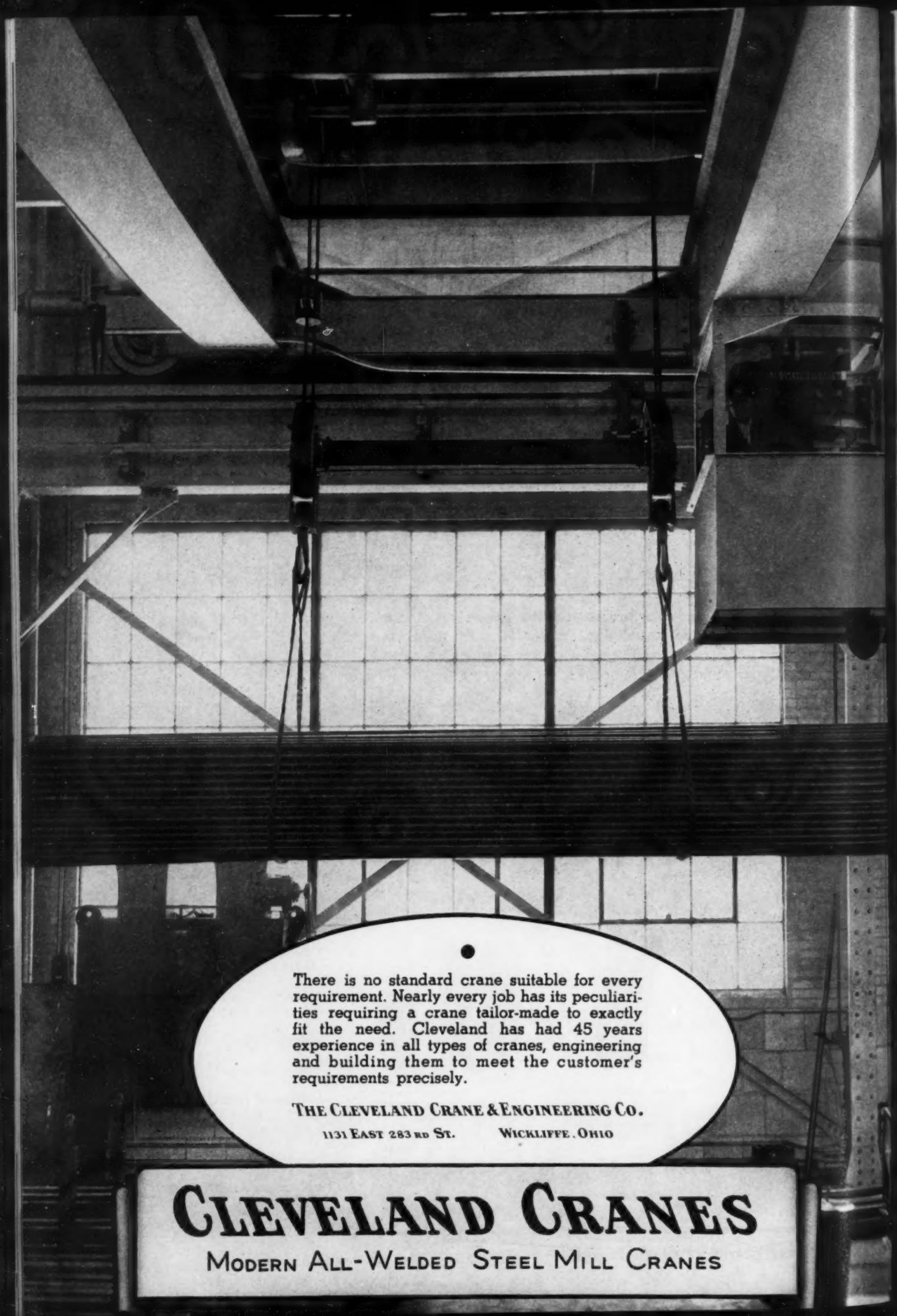
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Crops *and* Shorts

WE strongly suspect that all of us know that the war has ended and have celebrated that event in our own particular way. We have also been advised by the papers that peace is again with us. Of the latter, we have our doubts. The end of war does not necessarily mean peace, which cannot come without a recognition of things other than material values. Already, new lines are drawn as countries, groups and individuals jockey for position in efforts to obtain greater material possessions — possessions which cannot in themselves bring peace or happiness and which in fact sow further discord among the seekers. The outlook can be naught but further strife — both international and internal — unless there is some return to the spiritual values which we seem to have discarded somewhere along the line. Maybe a little good, old fashioned religion would help.

▲

WAR'S sudden ending brought resultant cancellations of war contracts much sooner than expected, with many dislocations in employment. Steel production, down in July, dropped still lower in August. Industry is convinced, however, that reconversion will be fast and employment generally high. Indicative of this confidence are the many projects already announced by the steel industry. United States Steel Corporation, though characterizing their reported new plant in New Jersey as "pure rumor," is spending an estimated $27,500,000 in Carnegie-Illinois and T. C. I. plants for an expansion of tin plate capacity and modernization of blast furnaces, and $25,000,000 at Columbia Steel. Bethlehem has an extensive modernization program in progress at Lackawanna. Great Lakes is expanding their cold mill facilities. Republic has announced a $7,000,000 program in flat rolled facilities, and Jones and Laughlin a $12,000,000 tin plate expansion. Wickwire-Spencer is spending over $1,000,000 for various modernization steps, while Weirton is planning a $12,000,000 expenditure and Allegheny-Ludlum a $5,000,000 expenditure. Wheeling has some expansion plans as yet unannounced.

▲

WITHOUT wishing to cast any aspersions on the bedeviled holders of the late A-cards, we can't help but notice that we again have with us the driver who firmly plants his left wheels on the center stripe of the road and just barrels along.

POSTWAR industrial use of electric power is expected to be almost 80 per cent higher than in 1939, but still some 16 per cent under present wartime peaks. Although there are now nearly 70 million horsepower of electrical generating capacity in the United States, utility systems are spending and planning to spend large sums for new facilities.

▲

THERE are many people who are in danger of taking cold when they are wrapped in their thoughts.

▲

MUCH in the technical news of the past couple of years are those "auxiliary exciters of special characteristics" which have received such wide application in electrical control installations. Variously known by their respective manufacturers as amplidyne, rotatrol and regulex, there is no simple generic term for these devices. It is not without a feeling of temerity that we would like to suggest some such word as rotalexadyne, amplirotalex, dynalexatrol or what have you as a means of denoting these units without using a whole mouthful of words or a trade name. We're open for suggestions.

▲

WE believe it was Thomas Marshall who said that the country needed a nickel cigar. We've got 'em now but they cost several times that.

▲

A SURVEY made for RFC by an engineering firm places the present value of the Kaiser steel plant at Fontana, California, at $58,000,000. Another survey made for Kaiser Company, Inc., by a different firm of engineers sets Fontana's excess war costs at $73,600,000, which puts the present value at about $38,000,000. A lot of building could be done on the difference.

▲

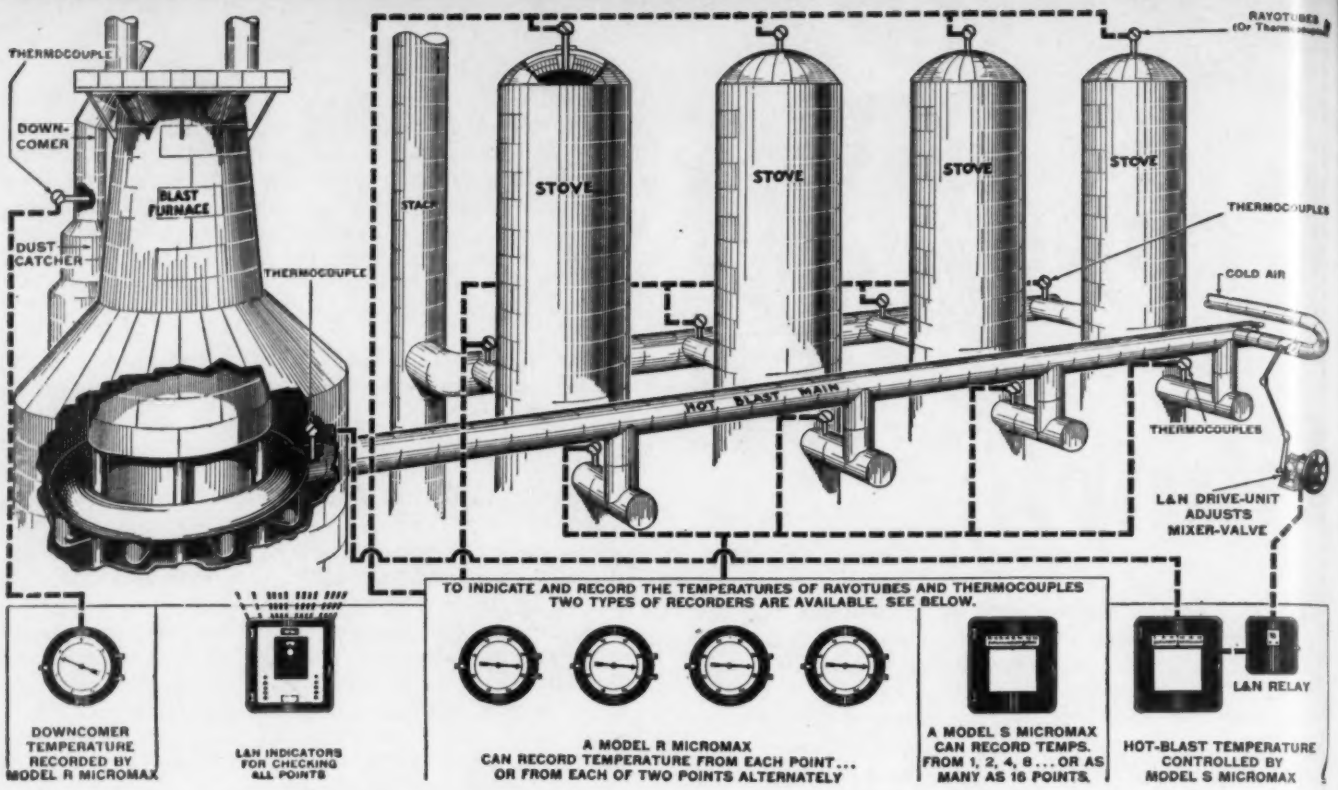
NEWS releases telling about their originators' roles in developing the atomic bomb are thicker than E-awards in their prime. Apparently everyone was in on it except our laundress and ourselves, and we're not quite sure about the laundress.

▲

NORTHWESTERN University has announced a new one-year course designed to train talented writers in the techniques of writing daytime radio serials. Judging by our present radio serials, which allegedly are what listeners want, talent would be wasted.

▲

A CANNER in Watertown, Massachusetts, Gennaro Capaldi, inserted an ad in his local newspaper offering to can and ship any service man's favorite food that was brought to him. Mothers, wives and sweethearts immediately responded, bringing in all kinds of home-cooked favorites. More than a half-million cans of home-prepared foods were thus sent overseas.


THERMOCOUPLE
DOWN-COMER
BLAST FURNACE
DUST CATCHER
THERMOCOUPLE
STACK
STOVE
STOVE
STOVE
STOVE
RAYOTUBES
THERMOCOUPLES
COLD AIR
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A MODEL R MICROMAX CAN RECORD TEMPERATURE FROM EACH POINT... OR FROM EACH OF TWO POINTS ALTERNATELY
A MODEL S MICROMAX CAN RECORD TEMPS. FROM 1, 2, 4, 8 ... OR AS MANY AS 16 POINTS.
HOT-BLAST TEMPERATURE CONTROLLED BY MODEL S MICROMAX

COMPLETE TEMPERATURE CONTROL for the BLAST FURNACE

The diagram above shows how Micromax Pyrometers are being used today to give complete control of temperature in the operation of blast furnaces. Installed at a convenient point, on a panel which centralizes all data about furnace operation, these Micromax instruments represent the best modern practice in temperature-control of a process which has "always" used many L&N Pyrometers.

A highlight is the regulation of hot-blast temperature in such a way that the blast remains at a *steady* temperature. After a brief leap upward when a fresh stove is put "on air," the blast returns promptly to temperature. Without undershooting or cycling, it settles to the control point and stays there, supplying blast at the uniform temperature so desirable in making today's uniform cast iron and steel.

Another and more recent highlight of Micromax instrumentation for blast furnaces is the use of Rayotubes, instead of thermocouples, for detecting stove-dome temperatures. The hot, chemically-reducing gas cannot affect Rayotubes, and the design worked out especially for stove domes is proving very satisfactory in the several dozen installations now operating.

Further information will be sent on request.

Part of Blast Furnace Control Panel of Iron and Steel Division, Kaiser Company, Inc., Fontana, California. Shown are Strip-Chart Micromax Recorders for stack and stove temperatures, and a Round-Chart Controller for the hot blast.

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"Saves us $7000 a year," says Regulex Control User

An example of savings that scores of furnace operators have discovered with most popular electrode control in industry today.

ACCORDING to figures compiled by one steel foundry, Regulex control on an 11-foot shell arc furnace saved $7000 over a year's period, in power and time savings alone.

Following the introduction of Regulex control for arc furnaces, its cost-saving performance quickly won the confidence of electric melters. *Within the past three years, the Regulex set has outsold every other type of electrode control.*

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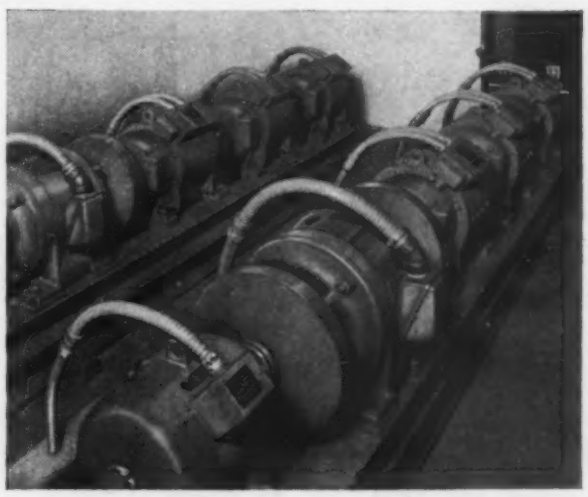
By accurately controlling electrode position during all the changing conditions of the furnace charge, Regulex control lowers kilowatthour cost per ton of steel. Melt-down time is shortened . . . furnace output is boosted. Many users have found that Regulex control pays for itself within a few months!

Your arc furnace manufacturer will be glad to tell you about Regulex control for new or existing furnaces. Or write directly to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

Furnace controlled by Regulex generators



Regulex control flywheel sets

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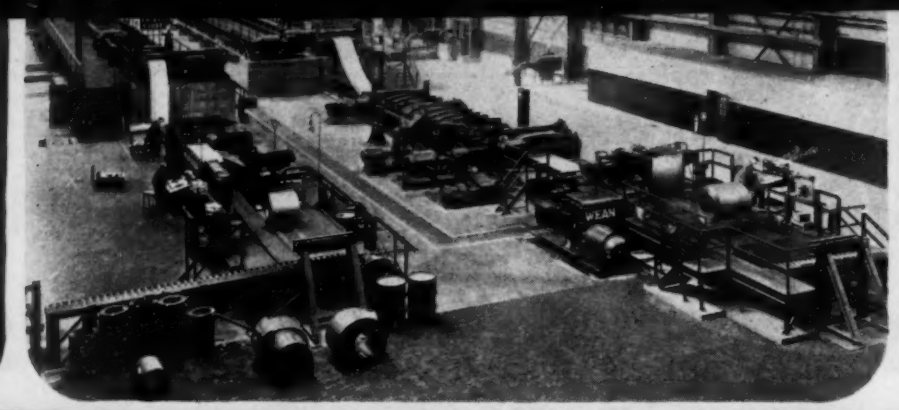
A 1888



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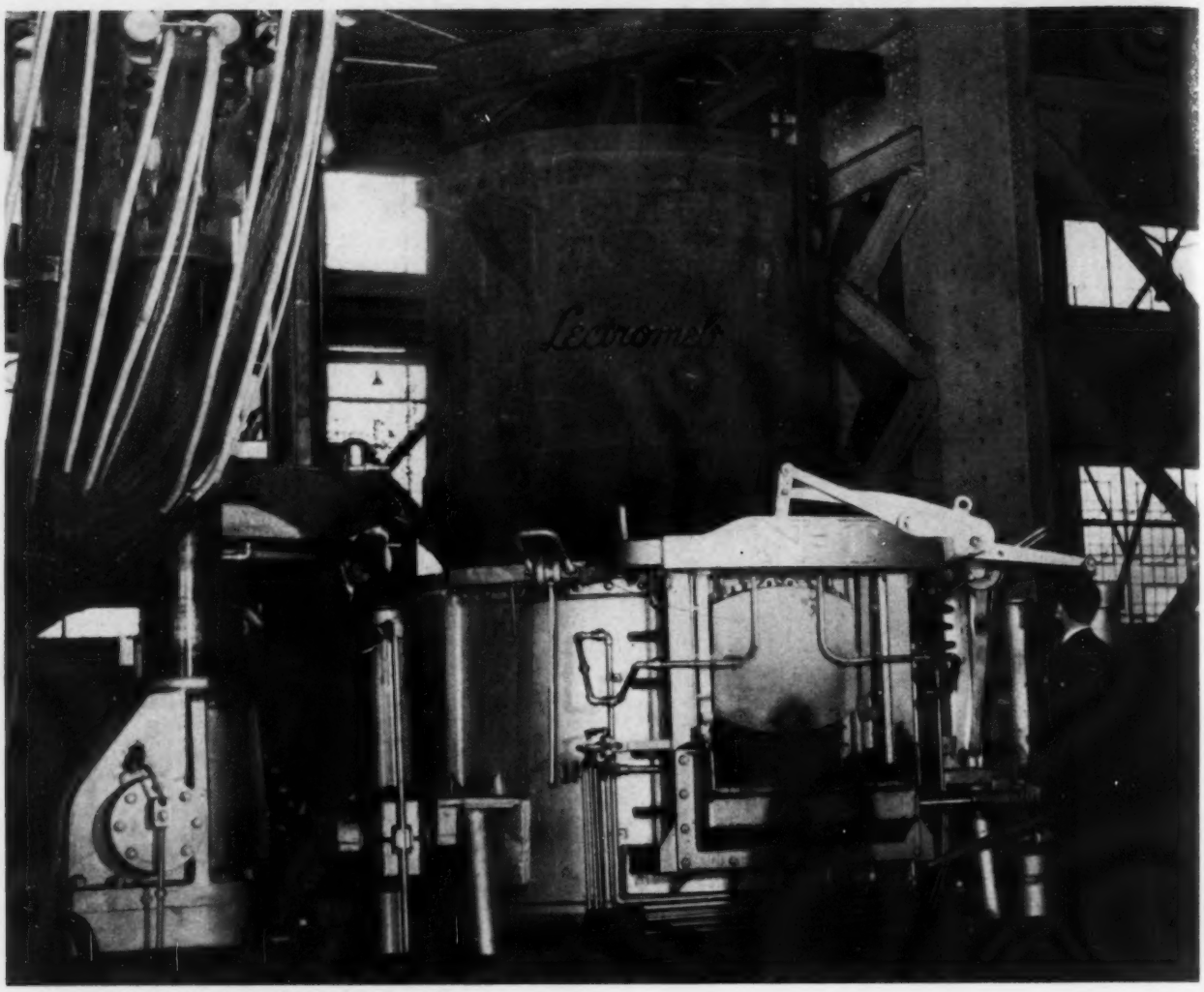

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Lectromelt, Size N, is identical with Size NT with exception that it is door charge instead of top charge.

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LECTROMELT NT SPECIFICATIONS

(a) Usual acid steel hourly rating..... 10 tons

(b) Usual size of heat.....15 to 20 tons

(c) Has poured in one heat.....40 tons

(d) Usual KVA rating.....6000 to 7500

(e) Shipping weight—furnace with electrical substation and control equipment (approximate).....NT 120 tons
N 105 tons

(f) Shipping weight —2 linings and 50 electrodes (approximate).....100 tons

(g) Volume data (e) 5000 cu. ft.
(f) 2500 cu. ft.

Alloy Steels FOR Maintenance

. . . . though perhaps higher in first cost, alloy steels save in replacement costs and in delay time . . . . their successful application requires intelligent analysis of duty requirements . . . .

by J. A. Rosa, METALLURGIST
REPUBLIC STEEL CORPORATION
CANTON, OHIO

▲ IN speaking on alloy steels for maintenance in steel plants, we shall be talking about heat treated alloy steels. Nickel, chromium, molybdenum, vanadium and all other elements which are added to plain carbon steel to make it an alloy steel are added for a specific reason. Nickel helps to strengthen the iron or ferrite; it makes a tougher steel. Chromium and vanadium are added to increase hardenability. Molybdenum increases hardenability and reduces the danger of temper brittleness. All elements, in short, are added to perform a specific task. None of them, however, can perform well if the steel is not suitably heat treated. In fact, under certain conditions, as will be shown later, lack of a suitable heat treatment may make an alloy steel perform very unfavorably.

By a suitable heat treatment is meant any treatment which tends to refine and toughen the as-rolled, as-forged or as-welded structure, and which promotes to the fullest extent the advantages to be gained by alloy additions. Heat treatment may consist of normalizing, of normalizing and drawing, or of quenching and drawing.

Alloy steels are at their best in large sections — sections such as are commonly encountered in plant maintenance work. The effect of mass on the tensile strength of heat-treated plain carbon steel (SAE 1050) and three of the commonly used alloy steels is shown in Figure 1.

From Figure 1 it is seen that, with increasing alloy content, the tensile strength is initially higher and remains higher as the size of the section increases.

The inherently higher tensile strength of alloy steels in large sections is of extreme importance to those who are charged with the responsibility of maintaining plants in full and uninterrupted production. While you may reasonably expect SAE 1050 (plain carbon) steel to have an ultimate tensile strength of 100,000 psi in a heat-treated one-inch diameter shaft, it would be foolhardy to use this steel in, for instance, a five-inch diameter crane hoist shaft which may be occasionally overloaded to 125,000 psi.

The inherently higher tensile strength of large section heat-treated alloy steels is due mainly to the higher (or deeper) hardenability of these steels. Although almost everyone today is familiar with the end quench (Jominy) hardenability test, we will review it briefly. From a great many experiments it has been determined that the hardness at the center of a quenched round section of a given size will correspond closely to the hardness at a specified point from the quenched end of a 1 in. round

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 25-27, 1944

hardenability test specimen of the same analysis. This test has made it possible not only to make a comparison of the hardenability of various types of steel but also to select a type of steel for a given application and forecast its hardness characteristics in large sections.

In Figure 2, for instance, we see that a steel of 35 Rockwell C hardness at the 1 1/16 in. position on the end quenched test will have the same hardness in the center of a 3 in. round oil quenched section or about 3 3/4 in. round water quenched section. Assuming then that we want to apply a steel on a job that calls for a minimum hardness of 35 RC (330 Brinell) in the center of a 3 in. oil quenched round, we have only to check the hardenability curves of a few types to find the suitable analysis.

Figure 3 shows that the plain carbon SAE 1050 steel

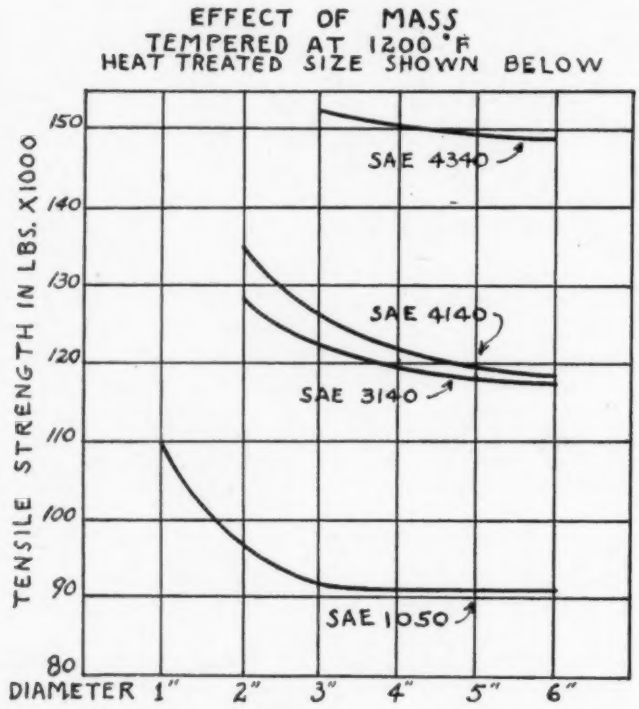
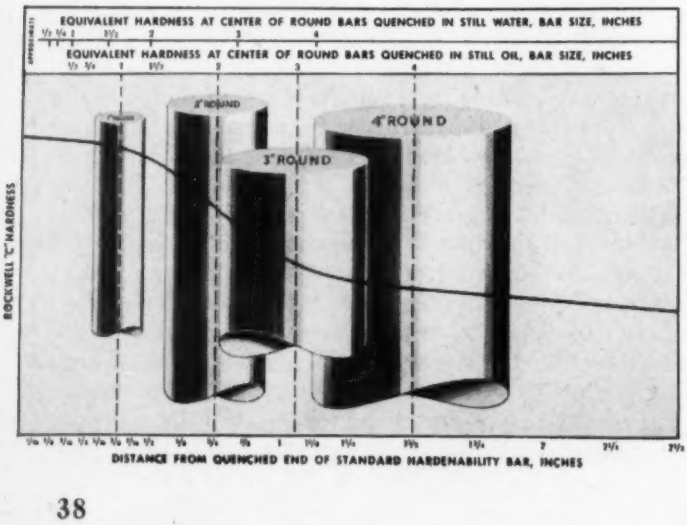


Figure 1 — Effect of mass upon strength of heat-treated parts of various types of steel (Tempered at 1200 F).

▲

Figure 2 — Equivalent hardness at center of round bars as determined by end-quenched hardenability test.


EQUIVALENT HARDNESS AT CENTER OF ROUND BARS QUENCHED IN STILL WATER, BAR SIZE, INCHES
EQUIVALENT HARDNESS AT CENTER OF ROUND BARS QUENCHED IN STILL OIL, BAR SIZE, INCHES
2" ROUND
3" ROUND
4" ROUND
ROCKWELL "C" HARDNESS
DISTANCE FROM QUENCHED END OF STANDARD HARDENABILITY BAR, INCHES

falls far below the required 35 Rockwell C hardness at the 1 1/16 in. position. All three of the alloy types, however, equal or exceed this value. Since all three alloy types meet the minimum as-quenched core hardness requirements, we are now faced with the problem of making a selection. Shall we use the SAE 4140, which just exceeds the requirement, or shall we go to the SAE 4340, which gives a wide factor of safety but which is also more expensive?

The selection and application of any alloy steel for plant maintenance work depends on a number of factors. No single mechanical or physical property test can be used to determine accurately all of the factors which should be considered in making a selection for a given application. Thus, although we have established that any one of the three alloy steels in the foregoing illustration will meet the minimum core hardness requirements, we have not yet considered any other characteristics of the steel or the other requirements of the application.

To select a steel properly for a given application, an analysis must be made of the job. Once the requirements and limitations of the job are known, the problem of fitting a steel to the job is relatively simple. Some of the factors which must be considered in making a selection are:

1. The size of the section.
2. The strength requirement.
3. The wear characteristics at high or low hardness.
4. The notch sensitivity or fatigue endurance necessary.
5. The response to the desired heat treatment.
6. The machinability desired.
7. The method of fabrication.
8. The resistance to corrosion necessary.
9. Strength-weight ratio.
10. Present and future availability.

It may be noticed that we do not list initial cost as a factor in the selection of steel for plant maintenance work. The reason for this omission is undoubtedly obvious.

It is axiomatic that to buy cheap is to pay dear. In these days of safety consciousness, it is sometimes difficult to determine which is the more important: a perfect safety record or a perfect production record. Undeniably, they go hand in hand. If a plant is so maintained that failures are at a minimum, accidents to personnel will be at a minimum and production at a maximum. To consider only the initial cost of an installation without regard to total maintenance cost is faulty reasoning and false economy.

The cost of a piece of steel going into a part upon which production on a million-dollar installation depends, may be considered in this manner:

	Carbon steel	Alloy steel
Cost of steel	$10.00	$ 20.00
Cost of labor	40.00	80.00
Total initial cost	$50.00	$100.00

Assuming that the part made from the plain carbon steel fails once in a year's operation while the alloy steel

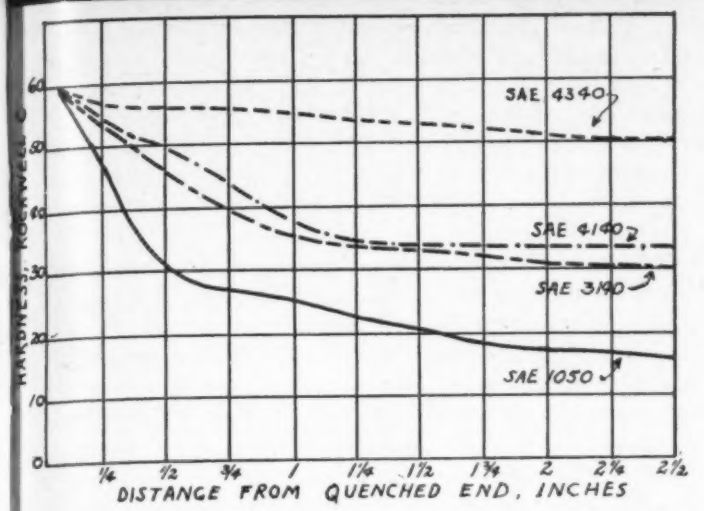


Figure 3 — Curves showing improved hardenability characteristics of alloy steels (broken lines) over plain carbon steel.

continues to give uninterrupted service, the balance sheet at the end of a year will look something like this:

	Carbon steel	Alloy steel
Initial cost	$ 50.00	$100.00
Cost of delay due to failure	500.00	.....
Cost of new part	50.00	.....
Total cost for 1 year's operation	$600.00	$100.00

This illustration is elementary; so elementary, in fact, that it is too often overlooked in selecting steels for plant maintenance work. It is one, however, which merits critical consideration if you are interested in maintaining plants at low cost and high efficiency.

Each of the factors which we have listed as being necessary of consideration could easily be individually the subject of a paper or even a book. Lack of time limits us in our discussion of these factors and our consideration of them will necessarily be limited to essentials.

It has already been pointed out that alloy steels are at their best in large sections. This is particularly true in parts over 2 in. in cross section. For large diameter shafts on cranes, tableroll trains, conveyors and other mill equipment subject to heavy constant loads or sudden overloads, the deeper hardening alloy steels are especially favorable. The ability of some alloy steels to harden uniformly to the center of even the largest sections used in plant maintenance work insures uniformity of hardness and structure from surface to center. Because of their shallow hardening nature, plain carbon steels cannot give this uniformity of microstructure and hardness in sections over 1 in. in diameter.

The strength requirement of a part must almost always be considered in conjunction with the ductility necessary. In most steel mill applications it is generally desirable to have a fair degree of ductility in the parts. Failures of parts of high hardness are usually of a brittle nature and generally occur without warning. A ductile part, however, usually gives some warning of impending failure, such as bending, twisting, or stretching.

Fatigue failure in ductile parts is of a progressive nature, often requiring days or even weeks to reach completion. This makes it possible in many instances to forestall actual failure by regular inspection of parts subject to this form of failure. The strength of a steel must also be considered in relation to its hardness. It is possible to obtain fairly high tensile strength at high hardness in carbon steels.

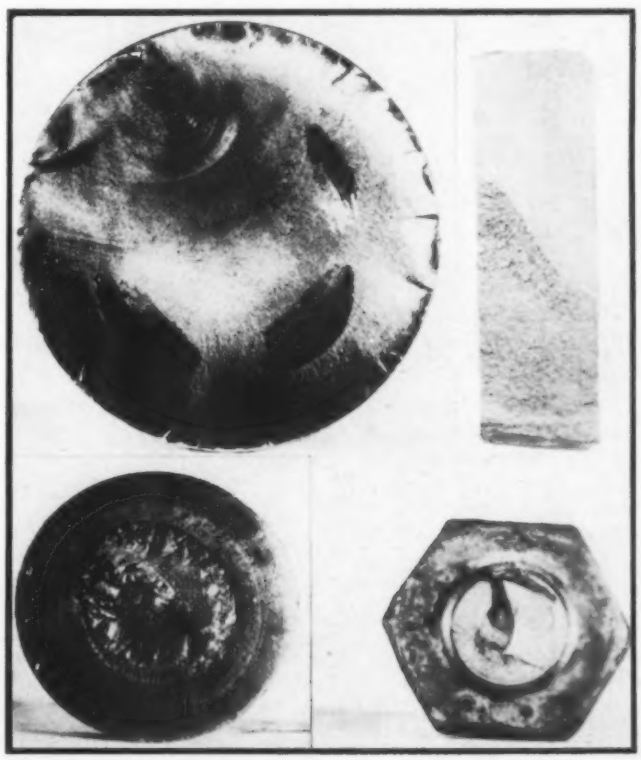
To obtain high strength in plain carbon steels it is necessary to sacrifice ductility. In doing this, the hardness is also increased. On the other hand, an alloy steel will in most instances give an equivalent tensile strength at a considerably higher ductility. This means that an application can be made that will possess high tensile strength and good ductility at a relatively low hardness.

The wear characteristics of a steel are of prime importance in certain applications. Guides, conveyor parts, drag bars, links, pins and similar parts undergo varying degrees of abrasive wear. In some applications fully-hardened, abrasion-resistant steels may be used. Other applications call for good ductility at low hardness together with a high degree of abrasion resistance. It is obvious that no single alloy steel can meet the demands of all applications.

The choice of a steel for a particular application may vary from a carburized or nitrided (case hardened) alloy of good strength and high ductility to a fully-hardened higher alloy type, or even to an austenitic manganese alloy of the Hadfield type. An analysis of the job with respect to the actual operating conditions will be your best guide in making a selection.

Parts used in steel plant machinery are almost with-

Figure 4 — Typical fatigue failures in various parts of mill equipment.



out exception subject to either repeated impact or reversals of stress, or both. A detailed study of many part failures in the writer's plants revealed that the majority resulted from fatigue, a considerably smaller number from direct overload or impact, and only a negligible few from metallurgical defects. Any revolving member such as a shaft, roll, drum, etc. is subject to bending stresses which may be imparted by gears, flywheels, hoist loads and so forth. Even parts apparently stressed in static tension, such as roll neck hanger bolts and cap bolts, are subject to repeated loading and unloading. The effect of these continual variations in bending, torsion and tensile stresses is ultimately to produce a fatigue failure. Some typical fatigue failures are shown in Figure 4.

Standard testing methods are in use today to determine the endurance limit or fatigue resistance of steels. The method most generally used is the R. R. Moore 0.3 in. diameter rotating beam test. In this test the specimen is run to failure under decreasing loads until a load is reached at which the specimen will have made 3,000,000 revolutions without failing. This value in terms of pounds load per square inch is then considered to be the endurance limit or fatigue resistance capacity of the steel. It is understood, of course, that the endurance limit of any particular steel will vary with its condition, depending upon whether the steel is in the quenched and drawn, normalized or annealed condition.

Table I gives a comparison of the endurance of an SAE 1045 steel and an alloy steel under identical testing conditions.

TABLE I

Steel and treatment	Endurance limits, psi		
	Polished specimen	Specimen with notch	
		1/8" deep 1/8" radius	1/16" deep 1/16" radius
SAE 1045, normalized and tempered to 85,000 to 90,000 psi	38,000	35,000	31,000
.25 per cent C., 2.75 per cent Ni steel, normalized and tempered to 90,000 psi	52,000	47,000	41,000

It is seen that even under the worst conditions of stress concentration (the 1/16 in. deep notch) the alloy steel has a greater fatigue limit than the carbon steel under the best condition — the polished specimen. For this reason the added fatigue resistance of alloy steels is an extra protection in applications subject to this form of failure.

The importance of heat treating alloy steels has previously been stressed. The response to heat treatment has already been indicated in the hardenability curves. This varying response to heat treatment plays an important role in the selection of a steel for a given application. Let us assume that we are going to make a line shaft four inches in diameter and fifteen feet long. Ordinarily, a steel of medium hardenability in the leaner alloy group would be selected for this application. But suppose that our heat treating facilities will not permit us to quench this shaft. In that case, it will be necessary to normalize and draw it. To get the desired strength from the normalized and drawn section, it will be necessary to go to a steel with considerably more "kick" in it. Knowing our heat-treating conditions and the strength requirement, we can then refer to hardenability and strength data of several steels and choose exactly the one to fit the job.

Since the fabrication of maintenance parts is seldom done on a production basis, machinability is not considered a major factor. It is desirable, however, to have the machining stock in its softest or most readily machinable condition. In most cases this can be arranged by annealing or normalizing and drawing the forgings or rolled stock for rough machining.

With the exception of parts intended for service at high hardness, the majority of maintenance parts seldom exceed 350 Brinell. This means that many forgings can be heat treated immediately after forging. The heat-treated part can then be finish machined ready for installation.

In recent years fabrication by welding has gained considerable favor and greater use in steel plants. This practice has materially speeded up repairs and replacements, and has also saved much equipment and money. However, it has been and can be the source of much trouble when alloy steels are used.

All alloy steels and plain carbon steels in the higher carbon ranges are air-hardening to some degree. This means that the weld zone in an alloy steel in the as-welded condition may be as much as twice as hard as the balance of the part. In service, this means that this zone will be hard and brittle, automatically becoming the focal point for stress concentration. Lacking ductility, the weld or weld zone soon fails. Failures in welded alloy steels make it appear that these steels are not suited for this method of fabrication. This, of course, is not true, for by suitable treatment the weld and weld zone can become as strong and as ductile as the base metal.

No welded or torch-cut alloy or high carbon steel part should ever be placed in service in the as-welded or as-cut condition. Welded and torch-cut parts must always be given at least a stress relieving treatment at 1000 to 1200 F. Whenever possible, these parts should be normalized and drawn. The necessity for a stress-relieving treatment after welding or torch cutting cannot be emphasized too strongly. Even the incidental use of welding has caused many failures. Such practices as "tacking" a bearing race, a gear or coupling in position on a shaft, of tacking pins, keys and bolts in position, of welding up small cracks and similar uses of welding constitute a hazard both to production and safety, and should not be tolerated. This also applies to the use of a cutting torch in fabricating alloy steels unless followed by a suitable tempering treatment. Torch-cut parts with sharp surface irregularities and shallow-hardened skins are especially prone to early fatigue failure.

Corrosion in steel plants varies from light atmospheric corrosion to attack by corrosive liquids and gases and has even been traced to bacteria. ("Corrosion of Water Pipes in a Steel Mill — C. L. Clark and W. J. Nungaster, ASM Transactions, 1943. Vol. 21, No. 2.) This

attack may take place at low or high temperatures or in fluctuating temperatures. A wide variety of special corrosion resisting alloys have been perfected to handle every type of corrosion problem. The selection of the proper steel for applications involving corrosion should, however, be left to an expert in this line.

Steel mill equipment has been traditionally built on a massive scale. One reason for this has been the permanency of much of this equipment. Another, and probably more important reason is that ever since the early days, plain carbon steel has been used in building this equipment. Use of plain carbon steels necessitated the application of heavy sections to withstand the incessant abuse to which this equipment is subjected.

Although no particular advantage is to be gained by reducing the weight of static equipment, direct and indirect benefits result from weight reduction without strength loss in mobile equipment. Cranes, rolling stock, conveyor systems and other forms of mobile equipment designed to the same strength requirement and built with alloy steels will be lighter than their carbon steel equivalents. Decrease in dead weight means lower starting, stopping and operating costs.

The substitution of alloy steels in present carbon steel mobile equipment without change in section or weight will bring indirect benefits in the form of increased pay loads. An example of this exists in one of our plants where a crane of 110 tons capacity was reequipped with alloy steel shafting and gears. This crane, with an original capacity of 110 tons, now has a capacity of 150 tons. This increase in pay load capacity was achieved without adding a single pound to the dead weight of the crane structure.

A final factor to consider in the selection of alloy steels is their present and future availability. We feel certain that alloy steels will always be with us. We cannot predict, however, that they will always be available in the present type and analysis classifications. We have seen many adoptions, revisions, and rejections of types, type groups and chemical classifications during the war. In the present emergency no steel producer can predict what changes in steel classifications tomorrow will bring. So, to those who are accustomed to thinking in terms of SAE, AISI, NE or other types, we would say: Select your steel on performance and you won't have to worry about availability. The labels may change but the inherent qualities will remain.

You who are charged with the responsibility of maintaining your departments and your plants in full and profitable operation are, in the final analysis, judged on one quality only: performance. Do you deliver the goods? If that is true of you, then why not use the same yardstick on the materials you work with. If you have decided to use a nickel-chromium-molybdenum steel for a certain application, will it matter if the chrome is a few points too high or the molybdenum a few points too low to fit a standard analysis, as long as standard testing methods show that the steel is capable of giving the performance you want? The answer, obviously, is no. It should not matter any more than it does whether an electrician or pipefitter or rigger has four or six fingers on his hand as long as he delivers the goods.

In our plants the job of selecting and applying steels for plant maintenance work is handled by a three-man board representing the engineering, mechanical and metallurgical departments. Each job is checked thoroughly for soundness of design, for method of fabrication and for the steel type currently in use. The group determines whether fillets are generous enough, whether sudden changes in section can be avoided or eliminated, whether keyways are properly located — in short, whether the design is fundamentally sound as judged by stress analysis and metallurgical considerations. The method of fabrication is thoroughly scrutinized. Is the part or assembly going to be welded, bolted or pinned, or will a combination of these methods be used? If forgings are involved, should they be heat treated and finish machined or should they be annealed, rough machined and heat treated before final machining? The final decision as to the type of steel to be used is made only after these and other matters have been thoroughly considered.

This method of job analysis and specific application has paid dividends in the form of increased service life, better safety and in some instances, increased capacity at no increase in dead weight.

We have been speaking of alloy steels largely in terms of the SAE grades. This is because the SAE specifications have in the past twenty years become the standard of all alloy steels. Furthermore, the majority of installations now in service are made of SAE steel types. Performance and service life data have been built up largely on these types. However, with the advent of the war it was found necessary to make substitutions because of the scarcity of certain alloying elements and because of the increased demand for those which before the war were considered to be abundant.

Under the supervision of the government and through the cooperation of the steel producers and consumers, the present NE grades were developed to carry on the work of the SAE types. Although the NE steels are generally spoken of as being substitutes, this label is not entirely correct. Many of them were developed to fill specific needs and some of them have proved to be superior to SAE types in specific applications. For the reasons we have already stated, it is difficult to make general recommendations either as to application or type of steel. We offer the following list of NE steels not so much as substitutes but rather as alternates for the SAE types.

SAE type	NE type
2300	8600 or 8700
2500	8700 or 9300
3100	8600 or 8700
3300	9300
4100	8600 or 8700
4300	9800
6100	8600 or 8700

This list comprises the alloy steels most generally used in steel plant maintenance work.

In conclusion we want to say that alloy steels as such are not offered as the final and complete answer to all maintenance problems. We do say, however, that under identical conditions of service, alloy steels will do a far better job than plain carbon steels. The successful application of alloy steels for maintenance in the steel plant depends to a large degree upon the intelligent choice of these steels.

APPENDIX

▲ A NUMBER of years ago the personnel of the maintenance and metallurgical departments of the Central Alloy District of Republic Steel Corporation, undertook to itemize and analyze specific mill maintenance applications and subsequently, to apply steels which they considered best suited for the job. Periodic revisions of the original list have been necessary because of changes in machine design, steel analyses and production methods. It is anticipated that further revisions will be made as time goes on.

To the present time the study has served to illuminate service performance of the available steels in the existing steel plant maintenance applications. Some of these data, translated into specific steel types and recommended heat treatments are presented in the following pages.

The list is necessarily abbreviated and incomplete. Most parts used in plant maintenance work resemble some other part either in service conditions, general contour, or both. In view of this similarity, it should not be difficult to specify a steel for parts not listed.

Whenever possible, more than one type of steel is recommended. The size of the section involved and the severity of the service condition will largely determine whether a single-alloy, two-alloy or three-alloy type should be used. All steels currently listed under AISI, SAE and NE classifications have been thoroughly documented as to hardenability and heat treated physical properties. With the aid of these data and with due consideration of other factors involved, the proper steel for a specific job can be readily selected.

It is recognized that all steel plants do not always have on hand the wide variety of steel types available in the plant wherein these data were developed. This, however, should not complicate the matter of selection inasmuch as choice should be governed by the requirements of the job and not by the stock on hand. The steels listed in the following pages are all standard types and are readily available either direct from producers or through warehouses.

Name of part	Type of steel	Heat treatment
— A —		
Arbors — For grinders	SAE 4340 NE 8740 SAE 6140	Oil quench and draw to 321/369 Brinell
Anvil blocks — Swagers	BF Dumost No. 3 (C 1.10% — V .30%)	Water quench and draw to 58/60 Rockwell C.
Axles — For crane, locomotive and critical applications	SAE 4340 NE 8740 SAE 6140	Oil quench or normalize and draw to 269/302 Brinell
Axles — Hot work*	AISI 309 AISI 310 Cast 25.00% Ni — 12.00% Cr	None
Axles — Corrosion resistant*	AISI 309-310-316-410-440	None
Axles — General	SAE 1015-1020-1030 1040 NE 8600 or 8700	Usually as rolled or forged and normalized

*The listed types are generally used. Specific application should be made only on the recommendation of a qualified metallurgical engineer.

Name of part	Type of steel	Heat treatment
— B —		
Bars — Pry, pinch, etc.	Carbon spring steel	Normalize or quench and draw to 450/500 Brinell
Bars — Chisel	Carbon tool steel	Quench and draw to 550/600 Brinell
Bars — Skid (for sheet and pair furnaces)	AISI 309	None
Bits — Lathe tool	Various high speed	As recommended by steel producer
Bits — Tong	Durodi (Ni-Si-Cr-Mo)	Quench and draw to 550/600 Brinell
	Stellite hard facing on SAE 1040	None
Bits — Stripper	Various hot work die steels	As required
	5½% Mo	Oil quench from 2000 F. Draw at 1150/1200 F to 400 Brinell
	SAE 52100	Forge and air cool
	Stellite hard facing on SAE 1040	None
Blades — Cracker and other cold shears	BF Dumost No. 2 (0.95%C—0.30%V) or similar type	Water quench and draw 500/550 Brinell
	Durodi	Oil quench and draw to 500/550 Brinell
Blades — Shear for hot cutting	SAE 5150 Durodi	Oil quench and draw to 400/450 Brinell
	5½% Mo	See Bits — Stripper
Blocks — Die (cold work)	SAE 52100 — Mo	Draw at 350/400 F
	SAE 52100	Oil quench from 1500/1525 F
Blocks — Die for forge hammer and press	Die block steels SAE 4350 Durodi	As necessary to 350/500 Brinell
Blocks — Lifting, for engine valves	SAE 4615	Carburize, quench and draw to 60/63 Rockwell C
Blowers — Soot	AISI 302-304-309	None
Bolts — For acid cars	AISI 302-304	None
Bolts — General	SAE 1015-1020 1030-1040	As supplied or as required
Bolts — Special	SAE 4330-4340 NE 8630-8740	Oil quench and draw to required hardness and strength
Bolts — Air hammers	NE 8740 SAE 6145	Oil quench and draw at 400/450 F
Bolts — For steam engines and air compressors	Agathon Engine bolt steel (2.75% Ni)	Oil quench and draw at 500 F
Bolts — foundation	SAE 1015	None
Bolts — Special tension for mill housings	SAE 2340-4340 NE 8630-8740	Oil quench and draw to 321 Brinell
Bolts — Side guard and any other special	Agathon Engine Bolt steel	None, or may be quenched and drawn

Name of part	Type of steel	Heat treatment
Bolts — Stay	Agathon Engine Bolt steel	None
Bonnets — Valve seats	Nitralloy	Standard nitralloy treatment
Boxes — Screw boxes for sheet mills	.25/.35 C 2.50/3.00 Ni	1525 F Air Cool
Braces	SAE 1020-1030-1040	None
Brackets	SAE 1015-1020-1030-1040	None
Broaches	BF High Speed steel or other high speed steel	As recommended by steel producer
Bushings — Chipping hammer	BF Dumost No. 1 (.80 C — .30 V) NE 8949	Quench and draw to 60/62 Rockwell C
Bushings — Wire straightener	BF Dumost No. 2 or other carbon or alloy tool steel	Quench and draw to 60/62 Rockwell C
Bushings — Straightening machine	Nitralloy	Standard nitralloy treatment
Bushings — Sizing rolls	BF Arrestite (.90 C — 1.55 Mn .25 Cr) or similar type	Oil quench from 1475 F. Draw at 400 F to 60/62 Rockwell C
— C —		
Cams — Shear	Nitralloy	Standard nitralloy treatment
	SAE 2320	Carburize, quench and draw to 62 Rockwell C
Castings — all large	Nickel Ni-Mo Ni-Cr-Mo	As cast or normalize and draw or normalize, quench and draw as required
Center — Lathe	SAE 52100 — Mo SAE 52100	Oil quench from 1500 F. Draw at 400 F to 62 Rockwell C
Chains	Wrought Iron	Annealed at intervals
	Herc Alloy	Water quench from 1600 F. Draw at 800/900 F to 285/300 Brinell
Chisels — Chipping	Special C-Mn-Cr-Mo-V	Quenched and drawn to 59/61 Rockwell C
Chisels — Hand	Carbon tool steel SAE 6145 Chrome-Tungsten Silicon-Manganese NE 8750	Oil quench and draw cutting edge to 58/60 Rockwell C Shank to 48/50 Rockwell C
Clamps — Wire pulley for draw benches	SAE 52100	Water quench from 1475 F. Draw at 350/375 F
Clutch — Jaws Plates	SAE 6150 NE 9850	Quench and draw to 444/477 Brinell
Collars	SAE 1020 to 1045	None or quench and draw as desired
Couplings — For shafts	SAE 1045-4340 NE 8740	Quench and draw to 269/302 Brinell
Cradles — Billet, in pickling vats	Ingot iron or high chrome-nickel types	None
Cutters — cold	SAE 4145 NE 9768	Quench and draw to 60/62 Rockwell C
Cutters — Turning machine	High speed steel	As recommended
Fingers — Gas producer	Ni-Mo casting (.40 C-.75 Ni-.25 Mo)	Quench and draw to 400/485 Brinell
Forgings	See specific application	
— G —		
Gears — Draw bench	SAE 4615	Carburize, quench and draw to 60/62 Rockwell C
Gears — Bevel	SAE 3140-4140-4340 NE 8640-8740	Quench and draw to 321/444 Brinell
Gears — Electric cranes	SAE 2340-3140-4340 NE 8740	Quench and draw to 321/444 Brinell
Gears — Transmission	SAE 2315-3115	Carburize, quench and draw to 60/62 Rockwell C
Gears — Heavy drive	SAE 2320	Carburize, oil quench from 1500 F, requench in water from 1425 F. Draw to 60/62 Rockwell C
Gears — Various large	Ni-Mo (.25-.45 C — 2.50-3.00 Ni)	Normalize or quench and draw to 321/440 Brinell
Gears — Motor with solid web	SAE 2350-4350	Quench and draw to 555/600 Brinell
Gears — Worm	See "Gears — Heavy	Drive"
Grips — Draw bench	SAE 2340-3140-4140 NE 8740-9850 SAE 52100	Oil quench from cyanide salt bath at 1500 F. Draw at 400 F
— H —		
Hammers — For hammer mill	Crucia (.80/.90 C — .25 Cr)	Quench and draw to 62 Rockwell C
Hammers — Hot heading	BF Unique No. 6 (.65 C-1.00 Cr-.25 W) or similar type	Oil quench from 1600 F. Draw at 500 F to 55 Rockwell C
Hammers — Pointer	SAE 52100 — Mo SAE 52100	Water quench and draw 500 F
Heads — Cross, for steam hammer	Durodi — .30 Mo SAE 4340-6140	Oil quench and draw at 500-1200 F as required
Holders — For jaws on stretcher levellers	SAE 3150 NE 9850	Oil quench and draw to 250/300 Brinell
Hooks — Common	SAE 1015-1020-1030-1040	None
Hooks — Chain	Same as chain	Same as chain
Hooks — Crane	SAE 1040 NE 8630	Normalize and draw 240/260 Brinell
	Herc alloy	1600 F water quench Draw to 285/300 Brinell
— J —		
Jaws — Draw bench	See 'Grips — draw b	ench"
Jaws — Straightening machine	C-V tool steel (.80/.90 C)	Quench and draw to 58/60 Rockwell C
Jaws — Stretcher leveller	SAE 5150-52100	Oil quench and draw to 60/62 Rockwell C
— K —		
Knives — Shear	See "Blades — Shear"	

Name of part	Type of steel	Heat treatment
— L —		
Liners — Knife, for mill shear	SAE 4330-4340 NE 8630-8740	Quench and draw to 302/321 Brinell
Links — Draw bench chains	SAE 2340-3140-4340 NE 8740	Quench and draw to 375/400 Brinell
Links — Open hearth ingot mold car links	SAE 4330	Normalize or quench and draw to 240/260 Brinell
— M —		
Metal parts — For car type annealing furnaces	AISI 302-304-309	None
— N —		
Nozzles — Air hammer	SAE 52100 and Mo NE 8750-8949	Quench and draw to 58/60 Rockwell C
Nozzles — Soot blower	AISI 302-304-309	None
Nozzles — Open hearth burners	Nitralloy	Standard nitralloy treatment
Nuts — Various	Same as bolt	
— P —		
Peels — Charging machine	C-V casting SAE 4340	Normalize and draw 241/269 Brinell
Pins — Chain, draw bench	SAE 2340-3140-4340 NE 8740	Quench and draw to 375/400 Brinell
Pins — Clutch, etc.	SAE 4150-6150 NE 8750	Quench and draw to 444/477 Brinell
Pins — Lever on hot mill housings	Agathon Engine bolt steel	Oil quench and draw at 500 F.
Pins — Pig machine	SAE 2315	Carburize, quench and draw to 62/64 Rockwell C
Pins — Chain grate stoker	SAE 6150 NE 8750	Quench and draw to 500/550 Brinell
	Nitralloy	Standard nitralloy treatment
Pins — Special	SAE 2340-3140-4340	Quench and draw to 302/321 Brinell or as required
Pins — Stopper, ladle	SAE 1015	None
Pins — Open hearth ingot mold car pins	SAE 4330	Quench and draw to 269/302 Brinell
Pins — Wheel and clutch for Bliss presses	SAE 2315	Carburize, quench and draw to 60/62 Rockwell C
Pinions — Crane	SAE 4340-5140 NE 8740	Quench and draw to 321/387 Brinell
Pinions — All kinds	SAE 2315-2320-3115	Carburize and quench Draw to 60/62 Rockwell C
	SAE 3140-4340-6140 NE 8640-8740 NE 8620-8720	Quench and draw to 321/512 Brinell
Pinions — Mill	SAE 4340-6140 NE 8640-8740 or carburizing grades as above	Quench or normalize and draw to 240/387 Brinell
Pinions — Motor	SAE 2340-3140-4340 NE 8640-8740	Quench and draw to 321/412 Brinell
Pinions — Locomotive crane, swinging	SAE 2335-4330 NE 8630-8730	Quench and draw to 321/412 Brinell

Name of part	Type of steel	Heat treatment
Plungers — Hydraulic pump	SAE 2315-2330-3140 NE 8630-8740 SAE 4340	Carburize SAE 2315 Quench and draw to 60/63 Rockwell C
Plungers — Pneumatic hammer	SAE 4340-6145 NE 8750	Quench and draw to 60/63 Rockwell C
Plugs — Roll turning	BF Dumost No. 16 and similar types	Quench and draw to 63/65 Rockwell C
Plates — Stripper and gauges	Cold rolled plates	None
Pistons — Air hammer	BF Dumost No. 1 or similar C-V steel SAE 52100 and Mo	Quench and draw to 60/62 Rockwell C
Pistons — Slag gun	BF Unique alloy No. 6 or similar carbon-chrome-tungsten type	Quench and draw to 60/62 Rockwell C
Pistons — Steam hammer	SAE 4340 Durodi .30 Mo	Oil quench and draw to 269/387 Brinell
	Nitralloy	Standard nitralloy treatment
Points — Pit crane tong bits	SAE 1045 hard faced with Stellite	None
	5½% Mo	Oil quench from 2000 F. Draw at 1050 F to 58/60 Rockwell C
— R —		
Races — Ball	SAE 52100	Quench and draw to 62/64 Rockwell C
Roller	SAE 52100	Quench and draw to 62/64 Rockwell C
	E 3310-4615	Carburize, quench and draw to 62/64 Rockwell C
Rams — Ingot	SAE 3150-4340 NE 8740-8747-9850	Normalize or quench and draw to 269/302 Brinell
Ravels	SAE 1015	None
Rings — Outer roll Rod pointer	SAE 52100	Water quench and draw to 60/62 Rockwell C
Rings — Halldén clutch	BF 404-Unique No. 8 or similar high C-CR-Mo-V type	As recommended by producer
Rods — Tie for acid cars	AISI 302-304	None
Rods — Stopper	SAE 1015	None
Rods — Piston for hammer and press	SAE 4340 — Durodi	Quench and draw to 302/321 Brinell
	Nitralloy	Standard nitralloy treatment
Rolls	Rolls are made from the whole range of steels, from plain carbon through special proprietary alloys. Depending upon the application, desired service life, cost, etc., rolls may be homogeneous, carburized, nitrided, hard faced on cast. An analysis of the specific application, together with the considerations above, will determine what type should be used.	
Rust — Parts where rust is a factor	Stainless	Annealed

Name of part	Type of steel	Heat treatment
— S —		
Scrapers — General purpose	SAE 1015	None
Screws — Housing, in sheet and tin mills	C .25/35-Ni 2.50/3.00 SAE 4330 NE 8630	Normalize at 1700 F Renormalize at 1550 F. Draw at 1100 F
Screws — Housing hot mill	SAE 2340-3140-4340 NE 8740	Normalize, oil quench from 1550 F. Draw to 269/302 Brinell
Screws — Shaper	SAE 2340-3140-4340 NE 8740	Same as above
Seats — Valve	AISI 309-310	Annealed. For high temperature, high pressure.
Seats — Valve	Nitralloy	Regular, for high pressures
Shoes — Die	SAE 1030-1040	None
Shafting — Under 5 in. diameter	SAE 2340-3140-4140 NE 8640-8740-9850	Normalize or quench Draw to 269/302 Brinell
Shafting — Large	SAE 4340-6145 C .25/.35-Ni2.50/3.00	Normalize at 1700 F. Renormalize at 1500. Draw to 240/269 Brinell
Sprockets — Crane, limit switch	SAE 5150 NE 8650	1550 F oil quench Draw 302/350 Brinell
Sprockets — Draw bench	SAE 4615 NE 8720	Carburize, oil quench Draw 400 F
Stems — For punch presses	High carbon-chrome or similar type tool steel	Oil quench. Draw to 512/555 Brinell
Studs — Roller and pig machines	SAE 6150 NE 8750	Oil quench. Draw to 495/555 Brinell
Studs	Wrought iron SAE 1045 SAE 2340	Annealed at intervals None Quench and draw to 302/321 Brinell
— T —		
Taps	Special tool steels	
Tonga — Hand	Straight carbon spring steel	Quench and draw to 302/418 Brinell
Tools — Cut-off forming and machine	Special tool steels	
Trackwheels — Crane	SAE 4340-4350 4360-6150	Quench and draw to 444/512 Brinell
Turnbuckles	SAE 1045	None
— W —		
Wedges	SAE 1045	None
Wheels — Sheave	SAE 4340-5150 NE 8640-8740	Quench and draw to 302/387 Brinell
Wrenches — Hand	SAE 1045 NE 8640	None Quench and draw to 341/387 Brinell
Wrenches — Housing screw	2¾% Nickel .30 Carbon	Quench and draw to 241/269 Brinell

DISCUSSION

PRESENTED BY

R. L. STEPHENSON, Assistant Chief Metallurgist, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania

J. A. ROSA, Metallurgist, Republic Steel Corporation, Canton, Ohio

T. R. MOXLEY, General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

R. L. Stephenson: In his paper on alloy steels for maintenance uses, Mr. Rosa brought out some very interesting points which I would like to emphasize with some of our own experiences along this line.

A problem at our plant, which is undoubtedly present in most of the plants, is that the equipment was built many years ago at a time when the specifications for the steel going into any particular job was left pretty much up to the discretion of the suppliers and they used whatever they believed would be satisfactory for the particular job.

Because of this, the performance of various parts was erratic. That is, crankshafts may last only six months or they may last as long as three or four years. Many years ago our maintenance department recognized this problem and decided that they would make a complete investigation of many of the failures that occurred in the plant as well as any parts which showed very poor service life, and upon this analysis they called in the engineering department and the metallurgical department for as much advice and assistance as they could obtain there.

Two points which came to light were that in many cases the alloy specifications used were those that had been used by the original suppliers and we found that the drawings often contained these alloy specifications but never specified a heat treatment.

We believe that in the days gone by there were quite a number of shafts and gears put into service probably without any heat treatment at all, probably in the annealed condition in which they were machined.

Another point that came to light in the study of the various parts in mill equipment was that many pieces of equipment that gave satisfactory service as measured by the time between replacements contained large quantities of only one alloying element.

Even before the war had started to steer us into the so-called ternary alloys for substitutes, we found that we could get much better performance if, instead of using alloys of only one alloying element, we went to two or three alloying elements, thereby reducing the total amount of alloy present in the steel, decreasing the cost and improving the performance.

The maintenance department has found that, in general, they have done a much better job with the use of alloy steels. They have reduced the repair work on many jobs and have cut down the expense and loss of production due to delays on the mill.

There is one type of steel that Mr. Rosa has not touched on very fully where we find that our maintenance costs are very high. There are many places

around the mill where the steel is subject to high temperature as well as to the other types of stresses.

I wonder if Mr. Rosa would care to make any suggestions for heat-resisting steels that can be used to advantage around the soaking pits, around the shears or the hot beds. Some particular items which have given us trouble, and on which I would like to get information are shear knives, slow-cooling pit cradles, bits for stripper tongs or soaking pit tongs.

J. A. Rosa: With regard to hot applications, we have the same problems that Mr. Stephenson mentioned and we are working to overcome them. In fact, we have increased performance life materially in many applications.

With regard to shear knives — I am speaking now of shear knives for blooming mills and other hot work shears — we have been using for some time a 5½ per cent molybdenum hot work die steel. We use this in the heat-treated condition and at a hardness of 387 to 410 Brinell. We find that it gives us very good life, comparing it with what we had available before.

We do not know yet whether we have reached the ultimate, whether we can get even more life by using another type. However, the improvement has been great enough to warrant continuing using this 5½ per cent molybdenum die steel.

For other hot-working applications around soaking pits, annealing furnaces, and so on, I would recommend going to an austenitic stainless type, such as the 25-12 (25 per cent chromium, 12 per cent nickel,) or even the higher alloying types. They are very good scale-resisting steels. They have high creep strength. They are very costly, but they do warrant their installation. The initial cost is high. However, the service life that you get out of them so far exceeds anything of steels of a cheaper type that they are well worth the trouble and the money of installation.

Stripper bits present a problem. We have tried many things, discarded almost everything. We did have a fair degree of success with the same 5½ per cent molybdenum die steel. Our trouble there was that the design was wrong. We are changing the design of the bit itself and we hope soon to know whether that is going to improve the working qualities of it.

Our trouble was not so much with wearing out of the bit itself as it was of breakage of the bit. It was, I think, a mechanical problem rather than one of steel or steel type.

We have tried hard-facing various types of bits, and the trouble we run into there is spalling. That may be due to improper preparation of the base metal or it may be simply that the work required of these bits is too much for that little bit of facing material put on there. We are still working on it; at present the most logical solution that we have is continuing working with these 5½ per cent molybdenum hot-work steels.

T. R. Moxley: There are a lot of things in Mr. Rosa's paper we should know — possibly we do, but we do not pay enough attention to them, perhaps because we are all too busy.

Everyone can remember the time when the biggest headache we had in the plant was the breakage of overhead crane axles. Since the advent and the application of alloy steels, the breakage of overhead crane axles is something you hardly hear of any more, and the same thing, of course, applies to every other unit in the plant where alloy steels are applicable.

Certainly, it has been a great help to maintenance men to have something that can give the service that alloy steel gives.

F. C. Schoen: I want to make one comment on Mr. Rosa's paper and that is a word of caution in using alloy steels, especially on old equipment. You can sometimes create a very big headache for yourself by making some simple little part out of alloy, and then just push back a little farther into the complete structure the piece that is going to break. I think you have to look into more than just the piece that is being replaced, because sometimes the little parts that are easily replaceable are the safety valve for an expensive, hard-to-replace piece.

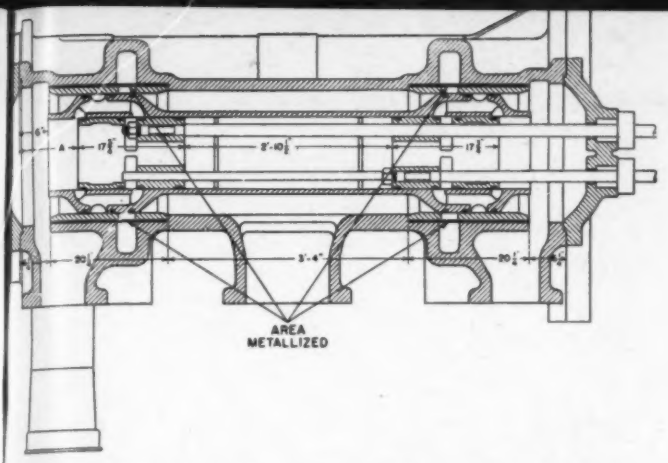
Metallizing - A MAINTENANCE TOOL

(Condensed from several issues of Metco News)

▲ AS the use of sprayed metal spreads and new and diversified applications are reported from various plants, it becomes more and more evident that the metallizing process is indeed a valuable tool in steel plant maintenance. Many cases are reported where cost savings are effected by reclaiming worn parts, but even more important, particularly in the drive of war production, are the applications that have enabled large production units to get back into operation without long delays which would have occurred had the process not been used. Summarized here are several of these cases which adequately speak for themselves.

In overhauling two steam driven blowing engines at one plant, it was planned to remove worn valve port bushings which were leaking badly and replace them with new, standard size parts. These cast iron bushings, in which operate piston type valves and in which port openings are machined, are shrink fitted into the large main casting which forms the high pressure cylinder and steam chest.

The repair was successfully completed in one engine, but in the second engine it was found that the bore in the main casting had been made approximately 5/16 in. larger than shown on the drawings. The new bushing, rough machined, was already .075 in. smaller than the bore it was to fit. Since the three-week delivery required for a new bushing would have carried past the time for blowing in the furnace, it was decided to try metallizing. Plugs were fitted into the open ends of the bushing so it could be handled in a lathe. The surface to



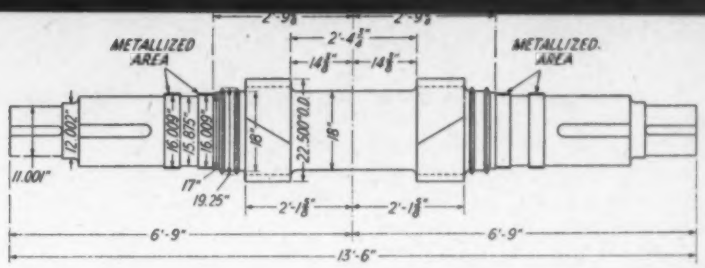


Figure 1 — When the bore in this steam chest casting was found to be larger than standard, sprayed metal was used to build up the standard sized valve port bushings as indicated. (above left)

Figure 2 — High speed shaft of reduction gear set, showing areas built up to restore damaged bearing fits. (above)

Figure 3 — Metallizing the surface of a turbo-blower shaft restored the worn, corroded area under the carbon seal rings on the steam end. (below)

be metallized was then prepared by cutting a full sharp thread (14 per in.) and knurling the thread apex to form a sort of dovetail which would serve as a lock to hold the sprayed metal.

Two spray guns were set up on the tool post of the lathe and the prepared surface was sprayed with 42½ lb of steel, adding about 3/16 of metal. The enlarged bushing, after finishing in a vertical boring mill, was shrunk into the main casting (using dry ice) without any evidence of the sprayed metal breaking away from the base metal of the bushing.

In another plant, when bearing fits on the 18 in. high speed shaft of a reduction gear unit were ruined through failure of a large roller bearing, it was found that it would take months to obtain a new one. This shaft consisted of two cut helical pinions (one right hand and one left hand) and carried two 14 ton flywheels. The damaged shaft was found to be .004-.008 in. undersize on the bearing fits. Accordingly, the bearing fits were turned down to 1/16 in. undersize and then dovetail grooved about 1/16 in. wide and 1/32 in. deep in a continuous spiral of 8 threads per inch. Steel was then sprayed on by a metallizing gun, bringing the bearing fits to 1/8 in. oversize, which were then ground down to the proper diameter for shrinking on a new bearing race.

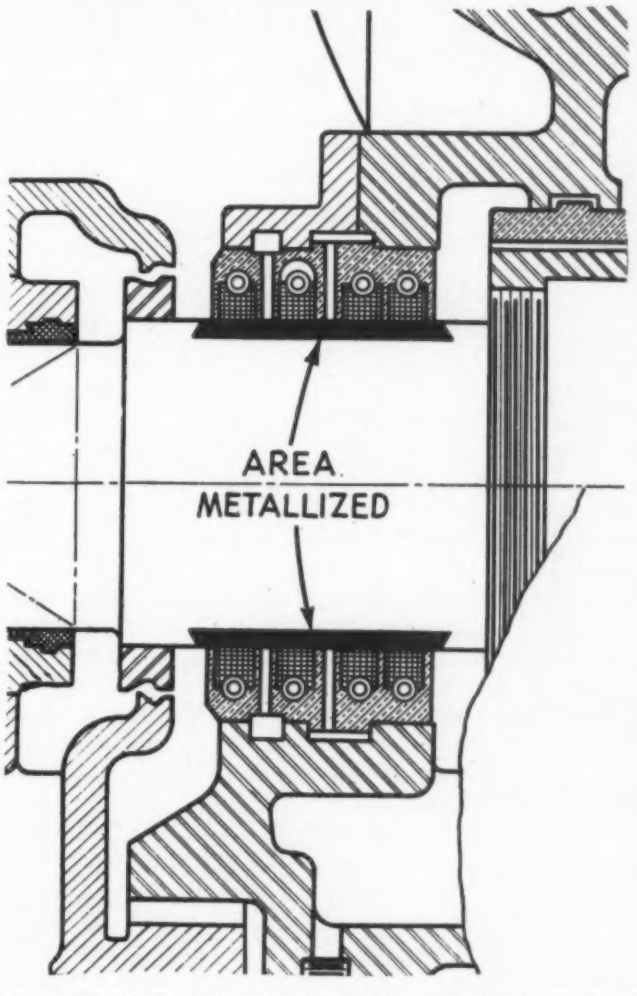
During the repair, it was found that the roller bearings were loose on the intermediate shaft also, and the same procedure was followed here.

Subsequent operation for almost two years has proven the worth of this repair method, which saved valuable production time on the mill.

At a third plant, corrosion (due to slight throttle leakage while idle) under the carbon rings sealing the glands of a turbine driving a blast furnace blower, coupled with the rings riding on the shaft over a long period of time, produced wear and an uneven surface which finally required renewal of the shaft. Delivery on a new shaft would be 18-24 months.

After deciding to metallize the worn sections, the shaft was placed in a lathe, and the corroded sections turned down smooth, then threaded and knurled. The prepared surfaces were then sprayed with a hard stainless steel and finally ground down to the original shaft size. Only 11 lb of the metal wire was required and a total of 24 man-hours of shop time for the job. The new surface is more resistant to wear and corrosion than the original mild steel shaft.

Other successful applications of metallizing reported from various steel plants include the building up of pistons, piston rods, pump rods and sleeves, valve rods and stems, axles, bronze bushings, slip rings on synchronous motors, shafts, charging machine peels, etc.



Three other rather unusual jobs were reported as follows:

Pickling tank agitating equipment, composed of shaft, rocker arms, connecting rods and plunger guides, sprayed with lead to prevent quick honey-combing from acid splash and fumes.

Billet mill roll neck, damaged by bearing failure, sprayed with copper and then with steel to reclaim roll for the remainder of its body length.

Worn babbitted bearings in a mill drive, sprayed with babbitt to save time so mill could get back into operation.

IMPROVED

Babbitting Methods

. . . . using a novel combination of equipment, modern production methods have been applied to babbitting, resulting in greater safety and economy . . . .

by George R. Park

BABBITTING SPECIALIST

MONACA, PENNSYLVANIA

▲ MAINTENANCE babbitting has been placed upon a semi-continuous mass production basis through the development of new ideas in the design of babbitting tanks and in methods for removing old babbitt and repouring.

The new type of babbitting tank consists of a gas fired stationary steel shell with a holding capacity of 5,000 lb of babbitt, and is divided into two sections by a baffle plate which extends above the level of the molten metal but does not reach to the bottom of the tank. Hence, the molten metal may flow under the baffle from one section of the tank to the other while grease, scum and dross on top of the metal are trapped back of the baffle and can be easily skimmed or burned off.

Clean babbitt from the second or "tapping" section of the tank is pumped by means of a two-cylinder reciprocating hand-operated pump (Figure 1) located in the molten bath. This pump will deliver up to 1000 lb of metal per minute, depending on the size of delivery pipe used and the speed of pump operation. A smooth, continuous flow of metal is maintained, and the speed of handling is such that babbitt may be poured at lower temperatures than in the conventional method of pouring, thus eliminating excessive contraction while at the same time permitting a good bond to be formed. The fact that the pump draws babbitt from below the surface of the metal bath keeps all dirt and oxide out of the bearing. With no molten metal to lift and no danger of spills, this method of pouring eliminates many of the safety hazards of babbitting. Patents have been applied for on the equipment, which is manufactured by the author.

Old bearings from which the babbitt must be melted are placed right into the molten babbitt in the first section of the tank, after first cleaning off the old grease. Thus the babbitt from the old bearing becomes part of the metal in the tank. Bearing shells up to 32 in. long x 32 in. outside diameter may be thus accommodated.

Burning out old babbitt by this method is 60 per cent faster than by gas flame, while heat is applied uniformly so that the old metal is not overheated, nor the shell warped. The bearing is burned out clean and grease is incinerated, and the old babbitt is ready for immediate reuse, saving time, labor and material.

After the old babbitt is melted out, the shell is removed from the tank, cleaned if necessary and set up for pouring. A cast iron plate is recommended on which to set up the works, as it draws heat from the bottom of the bearing and does not warp or buckle as a steel plate will. Holes in the shell are plugged with white pine plugs covered with a clean rag. Meanwhile, another shell is placed in the tank for melting out.

If care is taken to see that all scum, dirt and dross are skimmed from the tank before immersing the bearing

to melt out the old babbitt, the old bonding tin will not be seriously harmed. The tinned areas may be brushed with soldering salts and the shell dipped in a tank of tinning alloy, making it ready for filling. If the tin bonding has been damaged by mechanical action, shot-blasting may be necessary before painting with soldering salts and dipping.

When the bearing shell is set up, the delivery pipe from the pump is laid upon the shell so that the babbitt metal will flow around the mandrel. The molten babbitt in the tank should be stirred up from the bottom of the tank before pouring. The pump is operated and the babbitt flow maintained until the bearing is full, when the delivery pipe is removed.

When filling bearings placed below the level of metal in the tank, babbitt will of course syphon over after the flow is started by a few strokes of the pump. To stop this flow, a syphon valve is placed at the top of the pipe leading from the pump. Opening the valve breaks the syphoning action.

Figure 1 — Two-cylinder reciprocating babbitt pump, which does away with the conventional pouring.

▲

Figure 2 — Overall view of tank in action, showing ease with which babbitt is poured.

As the babbitt metal in the newly poured shell starts to harden and shrink, it should be puddled with a ¼ in. rod to keep the crust open. Additional babbitt should be added as necessary to make up shrinkage. Puddling should be kept up every two or three minutes until the babbitt is hard on top. The metal should set from bottom to top. Air blown around the bottom of the shell will aid this.

The bearing shell should not be excessively hot when poured — about 250 F is recommended. The mandrel should be about the same temperature. A very hot mandrel may cause air pockets and blisters in the babbitt liner.

Babbitt metal temperature is usually maintained at about 800 F for tin-base metals and 650 F for lead-base metals. Automatic temperature control for the tank is desirable.

In pouring new shells, tinning is strongly recommended to insure a tight bond between shell and babbitt. The new shell is first cleaned, removing burrs and foundry sand, and then heated to about 700 F to remove any oil or grease film, even though it appears quite clean. This should be done whether the shell is to be tinned or not. After the shell has been cooled so that it can be handled, areas where tinning is desired are shot-blasted until the surface is clean. Shot-blasting should not extend over surfaces where tinning is not wanted, as babbitt will stick there, requiring its removal by chipping, filing or machining. Shot-blasted areas should not be handled except with clean gloves or rags.

Soldering salts are then painted on the shot-blasted surface and rubbed in with a brush — dipping is not advisable. The shell is then dipped into a tank of molten tinning alloy, preferably ⅓ tin and ⅔ lead. The alloy should be 550-675 F; the bigger the shell, the hotter the metal. The shell is left in the molten bath until the metal will run off clean, and is then removed and babbitted immediately. If the tin coating is found to be defective, soldering salts should again be brushed on and the shell redipped. Arrangements must be such as to insure prompt pouring, as the bond will not be perfect if the tin cools so that it is set before the babbitt is poured. It will be noted that this method of tinning requires no acid.

It is recommended that new shells not be machine finished on the outside until after the babbitt is poured in order to insure a perfect fit in the housing.

Worn bronzes, brasses, wearing plates, bushings, etc. are reclaimed for further use by machining them down to allow for ⅛ in. of babbitt, burning off the grease and shot-blasting the areas where tinning and babbitting are wanted. These surfaces are brushed with soldering salts and the part then dipped into the bath of tinning alloy, set up and poured. The machine work on these parts may be smooth; anchors are not needed if a good bond is secured between the tin and babbitt.

The equipment and methods described here have been used for several years in the maintenance department of the Spang Chalfant Division of National Supply Company at Ambridge, Pennsylvania, and have resulted in improved economy and performance.

IMPROVED

Commutator Design

. . . . this patented design and the required materials for improving commutator performance is now commercially available for general use . . . .

by Paul McKeever

ELECTRICAL ENGINEER

AMERICAN ROLLING MILL COMPANY

BUTLER, PENNSYLVANIA

▲ EVERYONE connected with the maintenance of a steel plant will agree that armature repairs can be a very high cost item, as well as a bottleneck in the production of steel. In 1938 one company analyzed and classified their armature repairs with the following results:

1. 40 per cent required rewinding.
2. 35 per cent showed short circuit of front end of commutator bars, causing the vee-ring to be punctured and to flash to ground.
3. 15 per cent required work to be done on the shaft, such as rebuilding journals.
4. 10 per cent included damaged laminations and armature bands.

The front end of the commutator in many cases would be covered with oil film which would hold conductive particles and was the cause for bridging across the ends of the commutator bars. This arcing would eventually puncture the front end mica vee-ring and would go to ground. It was also determined that the most vital area was about ¼ in. in from the front end of the bar in contact with the vee-rings, as indicated by the following:

1. Highest percentage of initial breakdowns started in this area.
2. It is the point of highest potential gradient.
3. It is the point of low insulation resistance (easily carbonized oil and other conducting sludge).
4. Burning action in mica segment is progressive due to organic nature of all binders for mica, resulting in carbonized segments.
5. Final breakdown to ground is the result of spreading of carbonized area until the steel ring is reached, resulting in the familiar "rat-hole" appearance.
6. This "rat-hole" appearance can be seen on many cores, and the trouble can often be traced to the short-circuiting of the coil at the commutator, the short-circuited coil being subjected to mechanical stresses and excessive heating.

One of the first things to be tried was the installation of double vee-rings, with the result of a larger hole when it went to ground. The only difference was, due to the extra thickness of mica, a few more hours of operation were obtained but more damage to the armature resulted when it did go to ground. The next step was to increase the creepage distance on the front end of the commutator and to use a noncarbonizing material in doing so. This job is carried out in successive steps as follows:

1. Counterbore the front end of the commutator to a depth of $\frac{1}{32}$ in. and from ¼ in. to $\frac{5}{16}$ in. width of groove, measured from the point of contact with the vee-ring.
2. Rabbet one half the width of the bar without disturbing the mica, using ¼ in. to $\frac{5}{16}$ in. radius.
3. Place the armature in a baking oven in a vertical position with the front end up.
4. Pour the high temperature liquid compound in the machined recesses until level with the end of commutator bars.

Presented before A. I. S. E. Pittsburgh District Section Meeting, April 9, 1945

5. Bake from 8 to 16 hours at a temperature of 250 C.

The noncarbonizing compound used has an operating temperature of 200 C and a dielectric strength of 1000 volts per mil.

Approximately 25 armatures were equipped with this grooved and filled design in 1938. These armatures were placed on the toughest jobs and operated for one year as a test before changing over any more armatures. As the result of this test, it was decided to equip all the armatures in this plant as they came in the shop for repair. During the past seven years 900 armatures out of 1200 in the plant have been treated in this manner. There has not been to date a a ground or any other type of front end failure on these commutators. From a standpoint of economy the results are as follows:

1. During the year 1938, armature repair costs were $.05 per ton of open hearth steel produced.
2. During last year, their armature repair costs were $.015 per ton of open hearth steel produced.

All of these results could be discounted, and the grooved and filled commutator would still offer a big advantage because the danger zone is effectively sealed against oil and dirt. Or another way of putting it, you have the same result as if the front end of the armature were cleaned every day.

A marked improvement in banding practice has also been put into effect, using stainless steel strap bands in place of banding wire and applying them in the following manner:

1. Band is clamped in position by a band-pulling machine.
2. When proper tension is reached, through an aperture in the banding machine, the band is brazed together, using the proper flux and a low temperature brazing operation.
3. The banding machine is removed and brazing job finished.

This is a relatively new development but shows excellent promise in freedom from broken banding wires.

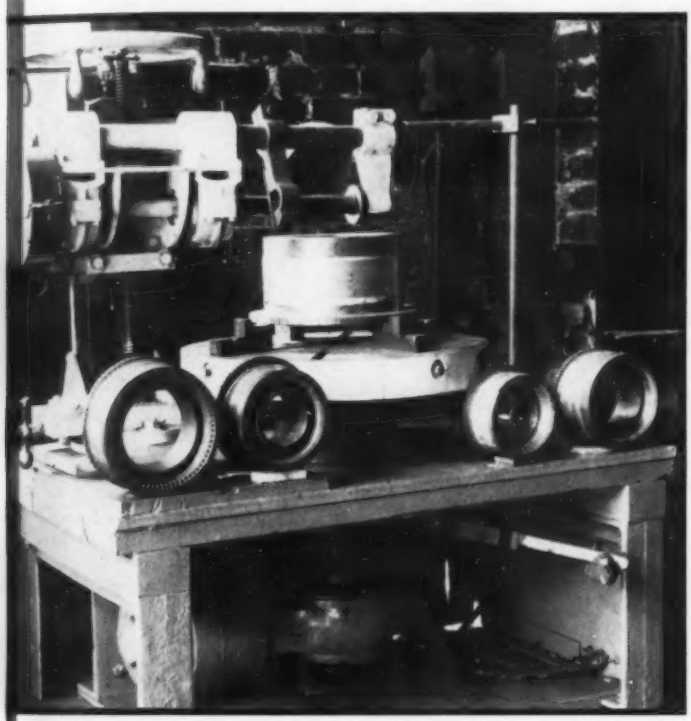


Figure 1 — Commutators are grooved and rabbetted on this machine. Finished commutators are shown along the front of the bench.

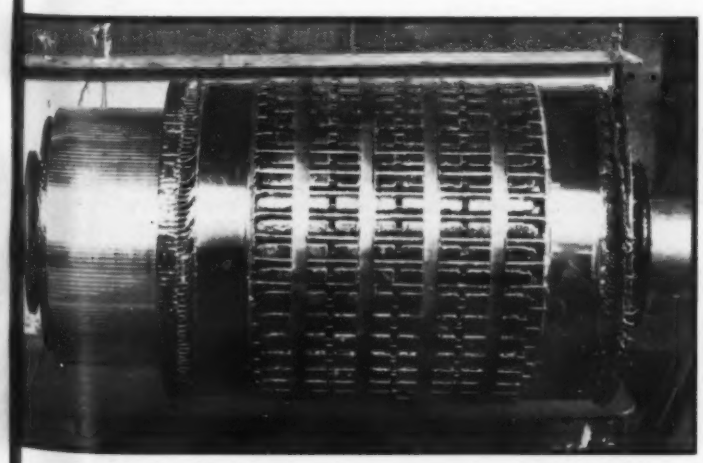


Figure 2 — View of completed armature with stainless steel strap banding.

DISCUSSION

PRESENTED BY

E. L. ANDERSON, Superintendent Electrical Department, Bethlehem Steel Company, Johnstown, Pennsylvania

PAUL McKEEVER, Electrical Engineer, American Rolling Mill Company, Butler, Pennsylvania

E. L. Anderson: About two years ago this commutator seal was brought to our attention. It looked very promising and we decided to try it out. Two mill-type armatures were equipped with this seal and were left in service for a period of one year before consideration was given to take over this seal for general plant use. During the last year we have equipped approximately thirty mill-type armatures and to date have had very satisfactory results.

The application of this commutator seal appears to be very promising. I believe, however, that it will be more advantageous on the older type oil lubricated armatures, as this type of bearing allows oil to seep out on to the front mica rings. I know from experience that Mr. McKeever's remarks relative to keeping dirt away from the cone rings lowers the failures of this part of the commutator, are correct. Sometime back when help was more or less plentiful, we set up a practice of washing our cone rings weekly. The reduction in commutator failures at this point was very gratifying.

There is one question I would like to ask Mr. McKeever and that is whether or not he applies the seal to commutators that have been in service. Up to the present, we have applied the seal only to new commutators, as it was our thought that in the old commutator the mica might possibly be oil-soaked and heat would cause the oil to work out and damage the seal.

I believe that there is a good deal of merit to this type seal, but do not feel that we have had enough experi-

(*Please turn to page 64*)

STORAGE AND HANDLING OF *Lubricants*

. . . . adequate storage and distribution of lubricants is essential to a well developed lubrication program . . . . cleanliness is essential . . . .

by L. E. Lovitt

SOCONY-VACUUM OIL COMPANY, INC.

PITTSBURGH, PENNSYLVANIA

▲ THE subject of storage and handling of lubricants has probably been discussed almost as much as any other phase of a plant lubrication program. The subject as stated deals primarily with lubricants but what is said about them can also apply to such allied products as slushing oils, cutting oils, soluble oils, roll oils, quenching oils, etc., because the storage and handling problems with these products are similar to those encountered with lubricants. Modern production methods have been accomplished by the introduction of highly specialized and intricate machines which have required the development and use of a greater number of lubricants and allied products of varying types and characteristics. This fact has placed greater importance on the necessity of close supervision of the distribution from storage to machine, on the use and handling of the proper lubricants required in any industrial plant; to those in the supervisory capacity, the storage and handling facilities are as important as a mechanic's tools.

Generally speaking, storage facilities should be planned and designed, first, with sufficient space in a heated building to accommodate an adequate supply of all types of lubricants and allied products used; and second, with efficient distribution and handling equipment. The size of the building or space allocated to lubricant storage will vary depending on the size of the plant and the number of products used.

The engineering department will, as a rule, design the building and should provide floor space for loading and unloading barrels, barrel racks, and tank storage if necessary. Space outside the building should be provided for empty barrel storage from where they can be returned to the supplier with the minimum amount of handling. Heated storage space is desirable in the winter time so that lubricants can be delivered to the machine or department at a temperature near that of normal operation, and in the summer time to maintain the lubricant at a fairly uniform temperature which will minimize the possibility of moisture condensing inside the barrels or storage tanks, particularly during the time of the year when there are hot days and cool nights.

In the larger plants a central oil storage house is necessary to reduce the quantity of lubricants stored in each department. Moreover, central storage may be used to store the large quantities of oil that some departments occasionally need when a central system is recharged. This thought brings up the matter of storage and distribution handling equipment. The quantities of various products required by each department depend naturally on consumption. On some items the consumption is low; therefore, in the interest of economy and to minimize the chance of contaminating the lubricant with dirt, scale, etc., better lubrication can be provided by issuing smaller quantities at regular intervals. Storage in a department then resolves itself to only those items where a less than full standard container is required at any one time. Then it is necessary only to provide suitable space in the department for one barrel of each oil used and space to accommodate whatever size containers are required for the greases used.

Barrel storage in the central oil storage house should

Presented before A. I. S. E. Pittsburgh District Section Meeting, April 9, 1945.

be accessible from all sides, and where multiple level racks are installed a portable lift platform is necessary to remove or rack the barrels. Any tank storage should be equipped with measuring pumps so that an accurate record can be kept of the oil used.

Where large quantities of oils are purchased in tank cars, tank storage large enough to accommodate a full car with sufficient reserve capacity to allow for shipping time should be planned. Unloading pumps should be installed to eliminate delay in emptying the tank car. Steam connections installed near the tank car siding are frequently necessary, particularly where heavier oils are received in this way.

Several different types and consistencies of grease are usually necessary to provide adequate grease lubrication. Here again better control of the distribution of the lubricant can be maintained by dispensing in quantities less than full drums. Grease pumps which can be used on the drum itself are about the best means of filling smaller containers. The selection of a grease pump is important. It should be of ample size and capacity to handle the stiffest grease used.

The problems involved in the handling of lubricants and allied products where they are used are many, and we should consider first the development of a complete lubrication program; and second, the responsibility of establishing the program developed. The ideal situation is to have one responsible head of the lubrication program who either supervises the actual lubrication of all equipment or, in the larger plants, delegates that authority to individuals who report directly to him. A well developed lubrication program includes not only a complete list of all lubricants used and points of application, but the frequency of application as well. The men responsible for the actual application must know what, how and when to lubricate, and have the necessary tools to work with.

In order to properly apply any lubricant, it is necessary that all points of application on any machine be readily accessible. Wherever practical oil-lubricated bearings and gears are served from circulation systems and grease-lubricated bearings from centralized grease systems, either automatic or hand operated. Other points are lubricated by hand. It is preferable that grease fittings should be standardized so that the different types of grease guns used can be kept to a minimum.

In plants where there are a number of machines with small oil reservoirs and several points of hand application, it might be advisable to design a compact cart large enough to carry sufficient quantities of oils and greases to completely lubricate one or more machines.

In a well-planned lubrication program each machine is scheduled for periodic lubrication. The men doing the work know what oils and greases are necessary and can get their supply either from the central oil storage house or the department storage before starting the day's work. Oil should be carried in covered containers and the grease guns filled in such a manner as to keep dirt from the product.

Charging grease into centralized grease system reservoirs should be carefully supervised to prevent any dirt or scale from getting into the system. Often grease is pumped from the drum through an adequate filter into the system reservoir.

Handling of lubricants in service is another important phase of a well-developed lubrication program. Regardless of how well bearings or gear cases are sealed, some form of contamination will usually find its way into the lubricant. On grease-lubricated bearings, one way to eliminate contamination is to add new grease frequently to the bearing and force a part of contaminated lubricant out of the bearing. Where effective bearing seals are employed this practice is not necessary, and if followed may cause injury to the seal.

Another way to eliminate contamination is to clean the bearing regularly and repack. On oil systems, either circulation or bath, some means of filtering may be necessary. The simplest method of filtering is by settling, allowing the oil to rest. The contamination drops to the bottom and clean oil is decanted from the top for further use. This method is slow and not very efficient unless the oil can be kept out of service for a long period.

Sometimes machines are designed with some form of oil filtering device included as part of the lubrication system, which provides for continuous by-pass filtration. These filters are installed primarily to remove abrasive contamination which, if allowed to remain in the oil, might score the bearings or gears, interfere with hydraulic valve operation, or damage the oil pump. Even so, it is often necessary to consider additional filtering equipment.

There are a number of different types of filters available, all of which have advantages and also certain limitations. There are the centrifuge, fiber-packed filters, fine-mesh filters, activated clay filters, blotter presses and magnetic filters. Before selecting a filter or establishing any system for purifying oils it is necessary to know the type of oil and type of contamination in the oil. Large circulating oil systems are equipped with continuous by-pass filters, usually of the fine mesh type. The chief contaminants in these systems are water and dirt. The by-pass filter will remove most of the dirt and a little of the water, but they will not handle large quantities of water.

Generally speaking, water can be removed from oil by settling or centrifuging for faster removal. Often we encounter cases where permanent emulsions have been formed which require special treatment before water will separate from the oil. Permanent emulsions usually can be broken up by heating the oil to about 180 F. In some cases it is also advisable to add one of a number of different types of emulsion breakers to the emulsified oil. In practically all cases, the addition of an emulsion breaker should not be done except on the advice of competent authority and under close supervision. After breaking the emulsion, centrifuging will remove suspended water and dirt particles remaining in the oil. In some instances, where the storage tank is not kept full and has large manhole openings, water has been effectively removed by heating the oil to between 180 F and 200 F, and then blowing with air. Most of the soluble oil emulsion contaminating machine tool circulating systems can usually be removed by centrifuging without heating or adding an emulsion breaker.

Reclaiming oils in a plant and the equipment required for the process require considerable study. Cost is the first consideration. Where large volumes of similar types

(*Please turn to page 56*)

ORGANIZATION OF A

Lubrication Department

. . . . results from a lubrication department are directly proportional to effort expended . . . . close cooperation between maintenance and lubrication departments is essential . . . .

by C. A. Bailey

LUBRICATION ENGINEER

CARNEGIE-ILLINOIS STEEL CORPORATION

GARY, INDIANA

▲ LUBRICATION has a long and interesting history. One of the oldest known instances is the use of fats to grease the axles of ancient chariots. History does not, however, record whether the grease was used to make it easier to draw the chariot or to cut down the shrill squeal of the dry bearing. In any case, we do know that the reduction of friction by some means of lubrication has been an integral part of the mechanical progress of our civilization. During the past 20 years great strides have been made in mechanisms, and likewise, great progress in the art of reducing friction. More and more attention has been given to the solution of lubrication problems as speeds and loads have increased. The necessity for proper lubrication is now appreciated and the value of a well organized lubrication department in relation to mechanical maintenance has been established. The most recent phase of this development is in the design of equipment so that it can be easily and properly lubricated.

Two small blocks of steel, sliding over each other, will serve to illustrate the basic fundamentals of lubrication. Unless a lubricant is used between them, any substantial loading of the two blocks will raise the friction to such a degree as to prevent sliding. Even though the bearing surfaces are polished, when two like substances are opposed, friction is high because of the tendency of the molecules of the two surfaces to interlock. Substituting a softer metal for one of the steel blocks reduces the friction, and so babbit is used for lining a bearing. Introducing an oil film still further reduces friction, so oil rings and grooves of various sizes and shapes are added to help maintain this film.

Rolling friction is far less than sliding friction, so the so-called anti-friction bearing, consisting of steel balls or rollers operating between an inner and outer race, has evolved. Even in this type of bearing there is still some friction and the use of a lubricant is required for best results under most conditions. Surface finish on the metals is important, but as yet no way has been found to replace film lubrication.

Oil is the most common and widely used lubricant, although other materials such as water or graphite are used in some cases to furnish the necessary film that separates two metal surfaces sufficiently to reduce friction in the necessary degree. The needs of the situation will determine the kind and type of lubricant, and it is significant to note that, as lubrication problems have arisen, the lubricant has been provided. Oil has been refined, modified, and used in conjunction with other substances such as soaps, metals and various chemical compounds to develop the desired characteristics for the lubrication problem at hand.

To many, lubrication merely means getting some oil or grease between two surfaces. Originally, that was a simple matter, easily performed by common labor. Such is no longer the case, yet the psychological effect still remains to hamper the developing prestige of the

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art and science of modern lubrication. Many of the so-called mechanical improvements are actually developed in an effort to reduce friction. Lubrication, however, is still essential and until some other way of eliminating friction is discovered, study as to the best kinds of fluid or plastic films must be continued, and new and better ways of applying them perfected. Knowing, therefore, that lubrication is essential, industry and science are endeavoring to make the lubricant more and more effective, easier to apply, and less expensive in first cost and application, as well as to perfect the mechanism in which it is used.

For example, take a machine having 100 bearings. If it is an old unit, undoubtedly many of these bearings are difficult or even dangerous to service and painstaking hand lubrication is necessary. How much better it would be if that machine were equipped with centralized lubrication. Then one grease pump, mounted on the machine, would supply lubricant through pipe lines to each bearing in just the right amount. And if the grease pump is driven by a motor with time clock controls, even better results will be obtained, for then lubrication becomes fully automatic and the machine can be operated with confidence that every bearing is being properly lubricated at all times. In such an evolution the common laborer with an oil can has been replaced by a craftsman capable of adjusting and maintaining the mechanism, and better results can always be expected from a skilled worker than from one who is not.

When setting up an organization to handle the maintenance and operation of mechanical equipment, it is advisable to make special provision for lubrication. Thus, one unit of the maintenance department, operating in close cooperation with the lubrication engineer, will be responsible for lubrication. Under such a setup, lubrication assumes its rightful importance and does not become an item to be taken care of only after all other mechanical work has been completed or an odd job to be done in spare time as is too frequently the case in many systems.

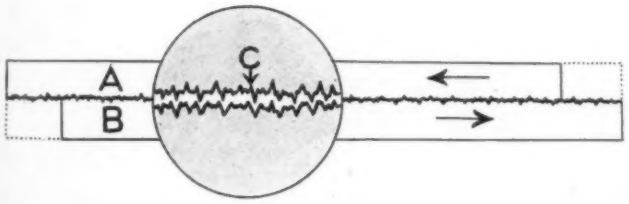
When a lubrication department is being established in a new plant the problems are quite different from those encountered when a new system is being installed in an old plant. In the new plant the machinery is modern and undoubtedly equipped with centralized lubricating systems or provision for easy, adequate lubrication at all times. To handle such equipment, the lubricating department should be staffed with craftsmen trained to maintain and service all the equipment in the plant. The size of the department and its organization will depend upon plant conditions and equipment, but its organization should be perfected at the first. Whenever possible, the lubrication engineer should work with those in charge of layout, operation and mechanical maintenance so that most effective lubrication equipment may be installed when the equipment is built and the whole coordinated to assure most efficient and economical lubrication at all times.

When a lubrication department is developed to handle the problems that exist in an old plant, entirely different conditions exist. Many of the machines may have been designed without particular thought of lubrication, or with only the hand oil can in mind. Sometimes the problem of lubrication is turned over to the operating department, allowing each operator to care for his own machine. In other cases, lubrication is handled in spare time by the maintenance crew. None of these approaches is too satisfactory. It is usually preferable to organize a specialized crew who can be trained in how best to meet the various lubrication problems involved and who can be schooled to appreciate the importance of proper lubrication in keeping old equipment operating efficiently.

In a well organized lubrication department, the lubrication engineer has the following duties, the list being, of course, subject to modification according to the size and departmental setup of the company or plant:

1. Ordering of lubricants.
2. Storage and dispensing.
3. Application.
4. Reclamation.
5. Installation of lubricating equipment.
6. Maintenance of centralized lubricating equipment.
7. Recommendations as to solution of lubrication problems and equipment for new machinery, cooperating with designers when necessary.

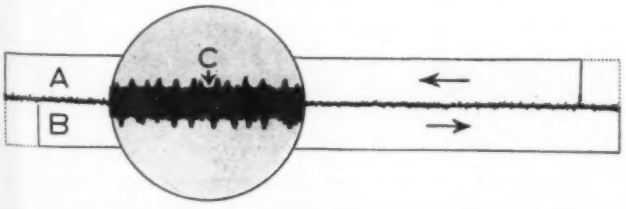
The number of lubricants should be limited to as few as possible, yet a sufficient variety of kinds and types must be provided to permit proper lubrication of the equipment in use. Too many different lubricants will increase storage problems and multiply the possibility of incorrect use of material. Too few lubricants may mean improper lubrication of certain equipment, either by using too good or too poor lubricant for the need. A survey of needs, listing each piece of equipment and the types of lubricant required to service it, will serve as a basis for setting up a system for controlling the ordering of lubricants. The most simple system identifies each different lubricant merely by consecutive numbers. The number of machines using No. 1 lubricant, multiplied by their needs, will indicate the quantity required



When two pieces of metal are brought together, contacting surfaces tend to grip one another because of rough surfaces which are visible under microscopic examination even on highly polished metals.

▲

The lubricating film, by separating the two surfaces, prevents the rough surfaces from gripping each other and thus reduces friction.



and any one can be told to furnish only No. 1 lubricant to certain equipment. Another system involves the use of numbers and letters to indicate the primary chemical and physical properties of the lubricant. Such a system lends itself more readily to an analysis of the kinds and types of lubricant and aids in avoiding unnecessary minor gradations in lubricants, thus keeping stock on hand to a minimum. Or, a system of names may be employed in which the name is descriptive of the lubricant or machine on which it is used. The system selected, however, is an incidental matter so long as the desired results are obtained through its use.

Much could be said on the subject of storage and dispensing of lubricants. This matter, however, is a function of the size of a plant and the set-up of the lubrication department. Adequate housing, however, should be provided in all cases to prevent losses in storage and dispensing. Outside storage is seldom entirely satisfactory, and it may be noted that storage racks capable of holding fifty-six drums of lubricant can be suitably installed in a floor space 7 ft x 14 ft in size.

Proper lubrication implies the preparation and intelligent use of charts, and thorough training of the lubrication crew in applying the proper lubricant in the correct way and at the right times under adequate supervision to assure that instructions are followed. Centralized lubrication systems such as are now available greatly reduce the need for personal supervision, and, being under mechanical control, are economical in material as well as labor needs.

Large savings can be effected by reclaiming lubricants in many cases. No two problems are alike, but a study of the operations, the type and quantity of lubricant used, the temperatures involved and the degree and kind of contamination will frequently show that the lubricant can be reused after suitable treatment. Various systems for reclaiming oil or other lubricants are available and a lubrication engineer should always study the economic possibilities involved in their application to his problems.

When new equipment is being studied, the lubrication engineer should consider the lubrication problems involved and submit recommendations as to how the equipment can be lubricated most efficiently. It may happen that the cost of installing centralized lubrication on the machine when it is originally built will be offset in a relatively short time by the savings in labor and lubricant which the system will make possible. Likewise, the assurance of efficient lubrication at all times should be considered in relation to maintenance costs and machine life, for it is safe to assume that a well-lubricated machine will last longer, cost less to maintain, and give better service over its entire life than will a similar piece of equipment not so carefully designed with regard to lubrication.

The results which may be expected from a lubrication department are directly proportional to the efforts expended. If the maintenance superintendent is convinced of the value of well-organized lubrication, the mechanical maintenance and lubrication departments can work in close cooperation and hold maintenance costs to a minimum while at the same time extending the effective life of the equipment. Neither group can operate to full effectiveness alone, for the work of each reflects upon the other.

Lovitt PAPER

(*Continued from page 53*)

of oils are used, it is possible to show considerable savings in the overall cost of lubricants by reclaiming used oils. The fundamental justification for oil reclamation is to keep the oil clean. Before investing in oil reclaiming equipment a careful study should be made of the nature of the contamination, the cause of contamination and the treatment necessary to bring the oil back to its original physical characteristics.

Mechanical filters, which effect no chemical change in the oil, are usually suitable for reclaiming a large percentage of the lubricating oils where the problem is one of removing dirt only. In systems where oils have been subjected to a high degree of oxidation, it is possible to develop sludges and other products of oil oxidation. In such cases, a more specialized method of filtration is necessary, such as the activated clay type filters. This type of filter can be used either as a continuous by-pass installation or for batch filtration. They are usually not recommended for use on additive-type oils because, in addition to removing dirt and oil sludges, some or all of the additive may also be removed.

Oils contaminated with solvents or fuel oil should be heated to a temperature high enough to drive off the lighter products. This can be done either before or after filtering. In most cases it is preferable to remove the lighter ends before filtering, particularly if any moisture is present. Here again, this type of oil reclamation should only be done under close supervision after a complete study of the effects the method has on the physical characteristics of the oil.

Where a large volume of oil is handled for reclaiming it may be advisable to install all reclaiming equipment at a central point where the process can be diversified to remove water, light ends, dirt or sludges.

Portable filters and reclaiming equipment can be used to advantage for removing water and dirt from oil in machines where it is not readily possible to drain the oil or where the production schedule will not permit taking the machine out of service.

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Water Supply

. . . . data based on current practice in actual installations where theoretical considerations were practically applied . . . . water systems should be as simple and flexible as possible . . . . water should be reused wherever justifiable . . . .

by C. D. Foight

DESIGN ENGINEER

CARNEGIE-ILLINOIS STEEL CORPORATION

HOMESTEAD, PENNSYLVANIA

▲ THIS paper attempts to point out the overall considerations and fundamental principles involved in the analysis of water requirements, the composition of a typical water supply plant, and the economical utilization of water. While steel plant water supply is the specific subject to which the author refers, the general principles of good practice refer to any industrial water supply system of similar characteristics. Considerable information of a general nature is available elsewhere but specific recommendations regarding sizing of passages and piping, selecting water works equipment, and laying out a flexible distribution system of adequate capacity are lacking. Attention is also directed toward the economical use of water by the various consumers. Since many of our operating difficulties are attributable to improper sizing of pipe and equipment, considerable stress will be laid upon velocities.

WATER REQUIREMENTS

Water is principally used for cooling purposes, scale flushing, process solutions, washing or scrubbing, high pressure descaling, and sanitary facilities. With the exception of some of the pit furnaces, annealing covers, slow cooling pits and preheating pits, almost every furnace, regardless of whether it be a blast furnace, open hearth furnace, reheating furnace, forge, or heat treating furnace, contains more or less water cooled elements. Water is used for cooling the air supply to motors and generators, for absorbing heat generated by air compressors, and for absorbing heat generated by bearings and other moving or rotating parts. The direct application of water to the rolls of a hot mill, the knives of a hot metal shear or a hot saw is familiar to every man in the industry. On cold reduction mills water is used as a roll coolant, either plain or as the main constituent of an emulsion. Many of our more recently constructed mills have solved the scale removal problem by using water as a conveying medium. Pickling, cleaning and numerous electrolytic processes require water, both for the process itself and for rinsing, washing or scrubbing. High pressure water is used for descaling purposes, being applied as high velocity jets from nozzles. Probably the sanitary facilities use less water than any other consumer, but the continuity of this service is most important.

Furnaces are probably the largest consumer of water for cooling purposes. In the case of almost any cooling element used on or in connection with a furnace, the sizes of tappings for supply and waste pipes have been determined by experience. These pipes must be large enough to prevent the formation of steam within the water-cooled element, and small enough to give the water a carrying velocity high enough to prevent their filling with mud. For estimating purposes, the velocity of flow through each supply pipe can safely be assumed to be 6 fps. Of course, there may be some elements ex-

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posed to the radiant heat of the furnace which should have 8 fps flow but there will be other elements, possibly embedded in the brickwork or even outside of the brickwork, in which 4 fps flow would suffice. However, the assumption of 6 fps velocity for all supply pipes will result in a reasonably correct estimate of total water demand for any furnace. In the installation of a new furnace, it is always well to inquire into the water demand of a similar furnace previously built and operated, as a check against the omission from consideration of some of the many cooling elements often built into the furnace. A simple approximation of the gallons per minute at 6 fps velocity can be made by squaring the pipe diameter (expressed in inches) and multiplying by 15.

For water jackets such as are found on bearings, air compressor cylinders and reduction gear drives; for intercoolers and aftercoolers; for oil or tar cooling coils; for electrolytic rheostat cooling coils; for heat exchangers on coolant or lubricating systems, etc., the water velocity assumption of 4 fps in the supply pipe will be reasonably accurate. A simple approximation of the gallons per minute at 4 fps velocity can be made by squaring the pipe diameter (expressed in inches) and multiplying by 10. In the case of air coolers such as are used for cooling the air in motor rooms, the pipe velocity may be assumed to be from 4 to 6 fps. The water passing through such coolers should always be used for some other purpose, also. In other words, such closed coolers should always act as a detour through which the water passes on its route to one or more large consumers.

For spray pipes and simple nozzles such as those used for cooling moulds, rolls, shear knives or product, an approximation can be made by simply using the formula for velocity $V = \sqrt{2gh}$ or $V = 8\sqrt{h}$, where h is expressed in feet. For instance, assuming a spray header to have a pressure of 28 psi or approximately 64 ft head, $V = 8\sqrt{64} = 64$ fps. Assuming the nozzle to be shaped so that the vena contracta can be neglected, and that the diameter of the hole is $\frac{1}{4}$ in., then the water demand of each nozzle will be $.25^2 \times 10 \times 64/4$, or 10 gpm.

In the case of spray nozzles, the aperature in the nozzle becomes larger in time as a result of the cutting action of the water supplied at high velocities. To allow for nozzle wear, the estimated water demand for any ordinary spray system should be increased roughly by 25 per cent.

One additional example is the case of a roll cooling spray header mounted on a mill, where it is desirable to have high impingement without allowing too much water to flow over the product. If the water pressure at the header is 111 psi or 256 ft and the nozzle has a $\frac{1}{8}$ in. diameter hole, then the velocity through the hole would be $V = 8\sqrt{h}$ or $8\sqrt{256}$ or 128 fps. In this case, the demand for each nozzle would be $.125^2 \times 10 \times 128/4$ or 5 gpm. For a 96 nozzle system, the total demand would be 96 x 5 x 1.25 or 600 gpm.

Hose connections, such as are used to cool ingot tops, slabs, etc., might be assumed to have a supply pipe velocity of 12 fps. A generous estimate of the number of pieces of hose in use simultaneously should be made.

Scale flushing, which has recently been applied as a method of removing scale, should require very little, if any, water in addition to that used for cooling product, rolls, or furnaces, or to that wasted after being used for some other purpose. However, in some arrangements, additional water must be introduced at the high point of the flume. Regardless of the origin of scale flushing water, the quantity required must be estimated in order to predict a satisfactory water balance and to insure satisfactory operation. The sluicing water required to convey light scale such as originates from plate, strip, structural or similar mills should have a minimum average velocity of 3 fps at the runout or delivery end to 4 fps at the scale breaker or first rougher, with a minimum depth in the flume of about 2 in. For medium heavy scale such as falls through a reheating furnace delivery table, the sluicing water should have a minimum average velocity of 5 fps with a minimum depth in the flume of about 2 in. For heavy scale, pieces of hot tops, slivers of metal, or such material as drops from the ingot delivery table or the approach table of a blooming or slabbing mill, the sluicing water should have a minimum velocity of 8 fps with a minimum depth of 3 in. There is no particular advantage in using a water velocity in excess of 12 fps. Where water velocity higher than 12 fps has been used, flume lining has had to be replaced more frequently because of the scouring or cutting action of the water and abrasive waste particles.

Process water requirements can be estimated only after a study of each process has been made. Consider-

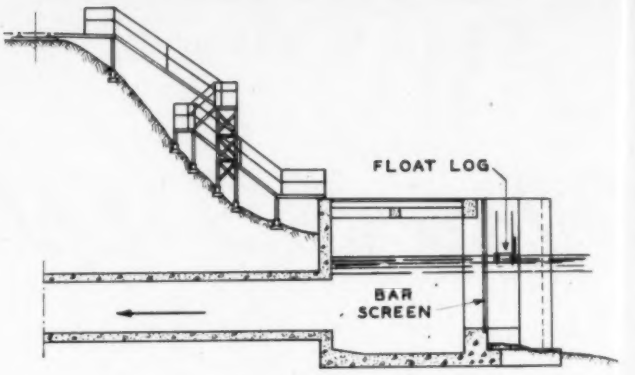
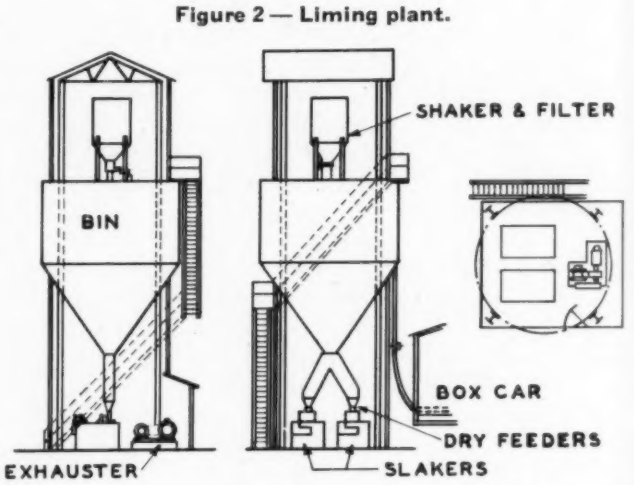


Figure 1 — Typical river intake.

Figure 2 — Liming plant.



able allowance should always be made for changes in operating practice. In pickling, for instance, the capacity of each tank and the frequency of replacing the pickling solution can be obtained without difficulty. However, an efficient operating force, by improving practice and making minor adjustments, may produce fifty, seventy-five, or one hundred per cent more product than the manufacturer's rating of a pickling line. Provision should therefore be made in the initial installation to insure an adequate supply to meet future requirements.

After the operators had stepped up production to the practical limit on one continuous pickling line, which was delayed intermittently for the purpose of renewing the acid solution in the successive tanks, the practice was changed by having the pipe work altered in such a way that new acid solution was fed continuously to the last acid tank. The solution flowed continuously from tank to tank, eliminating the necessity for recurrent delays.

It is possible to analyze cleaning and electrolytic processes for water demand, but in almost any process equipment will undergo alterations, and changes in operating practice are the rule rather than the exception. Scrubbing or rinsing requirements can be estimated either from the size of spray nozzles where sprays are used, or in the case of a rinse tank, by assuming a supply pipe velocity of 16 fps. After a careful study of actual requirements for process water, the total should be multiplied by at least 3 to provide for peak demands and changes in operating practice.

For descaling purposes, the water demand of each nozzle can be easily obtained from the nozzle manufacturer. The demand figure thus obtained should be increased by 25 per cent to allow for enlargement of the hole as the nozzle becomes old and worn.

To a large extent boiler house requirements depend upon the action of the feed water regulators, which open, throttle, or close intermittently and very often in rapid succession. Some boilers have a continuous blowdown in addition to the intermittent blowdown. A conservative method of estimating maximum boiler demand is to start with the known or anticipated steaming rate, add approximately 15 per cent for blowdown and multiply by two to cover peak demands for feed water. There may be some cooling water required for fan bearings, water backs, or other functions, the demand for which can be estimated as previously outlined. Water required for quenching ashes will have a supply pipe velocity of about 4 fps. Where ashes are handled by pumping to an overhead ash hopper or ash bank, an estimated pipe velocity of 8 fps will be adequate if the pump manufacturers' recommendation cannot be obtained.

Fire protection demand should not be overlooked nor neglected. At least four 300 gpm streams should be provided for. Any pipe line from which a fire hydrant is supplied should have ample capacity without excessive loss of pressure to deliver the additional 600 gpm required for two fire streams.

No miscellaneous consumers should be neglected from consideration. There may be acetylene generators, hydraulic elevators, closed hydraulic systems requiring makeup, closed cooling systems requiring makeup, debris removal sprays, strainer backwash, tong cooling boshes and other consumers too numerous to mention. On most of these items the demand can be easily estimated or the manufacturer's information can be used. For automatic strainer backwash requirement, it is never advisable to assume less than 10 per cent of the strainer capacity because of the increased amount of backwash required during bad water conditions. For tong cooling boshes, the velocity of flow in the supply pipe should not exceed 4 fps, although the pipe velocity is often closer to 8 fps.

PRESSURES

The service water pressure for general use should be at least 10 psi at the highest elevation of a service water pipe. In other words, if a waste pipe from an open hearth furnace door has an elevation of 40 ft above yard level, then the service water pressure at yard level should be 40 x .434 or 17½ lb plus 10 lb plus a pipe friction allowance, or about 30 psi. Probably most of the experienced steel plant men recognize the desirability of having a service water pressure of 30 to 40 psi at yard level.

For the roll cooling sprays on some mills, roller levelers or similar pieces of equipment, it is sometimes highly desirable to use sprays having greater impingement effect. These sprays are intended to wash off any particles of scale that might adhere to a roll. Recently, pressures of approximately 120 psi have been used for roll cooling. Generally either booster or recirculating pumps have been used to obtain this pressure.

Descaling water pressures are now averaging between 1200 and 1600 psi, although lower pressures of between 500 and 600 psi are still used in some plants. This pressure is invariably supplied by high pressure reciprocating or centrifugal booster pumps.

For fire protection, the service water pressure at yard level of between 30 and 40 lb is suitable if a fire truck with pump is available. The ideal pressure for fog nozzles is 100 lb; however, in an emergency, a fairly effective fog can be produced at 40 lb.

Service water, as the term is commonly used, means raw water which has been limed, screened and strained if and as necessary. It is used for general cooling purposes, flushing, as a supply to boiler feed treatment plant, descaling and all general service throughout the plant with the probable exception of supply for process consumers.

Filtered water is generally required for pickling, cleaning, scrubbing, electrolyte and coolant solutions. It is often required for roll and coolant sprays on flat product cold reduction mills.

Drinking water is generally purchased from the local municipality or water company. It may also be used for wash sinks, lavatories, showers, closets and urinals. This filtered water must meet daily bacterial count requirements, and must under no circumstances endanger the health of any employee.

WATER SUPPLY PLANT

The intake structure may be either off-shore in a lake or river, or it may project along a river bank. If possible, it should be so located as to make dredging unnecessary.

A large area of bar screens should be used to prevent floating or submerged debris from being drawn against the screens and obstructing the flow. Insufficient bar screen area will cause considerable difficulty during bad water conditions. Bars should be spaced about 2 in. apart and should be made in removable sections to facilitate replacement. The water velocity through the bar screens should never exceed 2 fps. Where river floods carry down leaves, trees and considerable debris, a maximum water velocity of 1 fps is recommended. Float logs several feet in front of the bar screens are very efficient in preventing floating material from being drawn against the intake.

The intake chamber should be proportioned for low water velocity. Where bad water conditions exist, a water velocity of .5 to 1.5 fps will permit precipitation of much material which enters the bar screens. The general arrangement should be such that the intake chamber can be clammed out.

In many arrangements an intake tunnel, conduit or pipe connects the intake chamber with the traveling screen chamber. It is important that such a tube have ample cross section area to prevent pumps from losing their priming because of too much loss of head between the intake and the pump suction pipes. Nevertheless, the minimum velocity in the tube should not be less than 2.5 to 3 fps to prevent a deposit from forming.

Water containing over 10 ppm of acid should be limed to prevent pipe corrosion. Lime should be introduced as milk of lime ahead of the traveling screens. An effort should be made to secure uniform distribution of the lime throughout the water so that segregation will not occur. Where the distribution is uniform all pumps and strainers are protected equally against corrosive action.

The lime used may be either slaked or unslaked. The type of unloading and handling facilities will depend upon the type of lime used. A pneumatic unloader is very satisfactory for handling bulk pebble quick lime from box cars to storage bin. The smallest bin for handling car load shipments should have a capacity of not less than 2000 cu ft. The bin capacity should be ample to provide for delayed car deliveries as well as bunched shipments.

Dry feed machines are recommended for proportioning the lime. Two machines should be provided, each of sufficient capacity to lime the maximum pumpage to an alkalinity of 10 ppm during the period of maximum acid content of the raw water. The dry feed machines are generally mounted on lime slakers or mixers, where the milk of lime is produced.

Where an acetylene generator station can be located conveniently, the lime sludge from the generators should always be used for service water liming purposes. This reduces the liming cost and eliminates the difficult problem of acetylene sludge disposal.

Two traveling screen chambers equipped with sluice gates and arranged for dewatering should be provided. At least one and preferably two traveling screens should be installed. The screens should be $\frac{3}{8}$ in. mesh of either copper or bronze. The maximum water velocity through the screens should not exceed 2 fps under normal operation. At times when one screen is out of service for repair, the maximum velocity would then not exceed 4 fps.

Where bad water conditions exist at certain seasons of the year, the service water pressure is not adequate to wash the debris from the screens. For satisfactory screen washing under such conditions, a pressure of at least 100 psi supplied by a booster pump is required. Debris from traveling screens should not be conducted to a point from which it will be drawn back into the intake.

From the traveling screen chambers, the water passes through a pump suction tunnel into which the pump suction pipes extend. Pump suction pipes should have a diameter of at least 1.5 times the diameter of the pump discharge nozzle and should be flared or bell-mouthed to reduce entry loss and minimize vortex formation. The entry end of the suction pipes should be well below the low water level in the pump suction tunnel. Where flood stages occur, a gate valve of the same size as the suction pipe should be installed so that pump suction can be shut off during the times the pump is being repaired or repacked. Where suction pipe size is reduced for connection to the pump, no air trap or pocket in the top of pipe should be permitted.

Centrifugal pumps are undoubtedly the most satisfactory. A minimum of three pumps of equal size and capacity, any two of which will meet the maximum water demand is recommended. Allowance should always be made for the future installation of additional pumping capacity. Pump manufacturers recommend that the vertical height from low water level to the center of pump be not over 12 ft. The 12-foot static suction lift may prove to be a 28 or 30 foot dynamic lift. The designer should carefully check the loss of head from the low water level at intake to the center of pump, including for each passage the entry loss, the friction loss, the velocity head loss, and the loss at sudden enlargements or restrictions, as well as the static lift.

Where there is no positive assurance that electric power service will be uninterrupted, at least two of the units should be steam turbine driven. The exhaust steam can be utilized in a hot-process boiler feed treatment plant.

Check valves in pump discharge piping should be non-slamming. They should be sized to prevent excessive loss of head. Where cone type check valves are used, an unfailing clear water supply having sufficient pressure should be used for the operation of the operating cylinder.

An adequate pump priming system should be provided. For this purpose steam ejectors are the most desirable while water ejectors are quite satisfactory if the water supply is unfailing. Motor operated vacuum pumps have also been used with satisfaction. The vacuum line should not only be connected into the top of the pump casing but it should also be connected to the top of the suction chambers in the top casing. Sight glasses in the vacuum pipes are an insurance against pumps being started before they have been completely filled with water.

A strainer should be provided in the discharge line from each pump. There are at least three good types of automatic strainers that have proven satisfactory. The strainers should have capacities equal to the pump capacity. Openings in the strainers should not exceed .063 in. and the velocity of the water through the openings should not exceed 3.25 fps. Automatic valves are

recommended for controlling the backwash flow in order to minimize the amount of water wasted, when such waste is unnecessary. Backwash from automatic strainers should also be piped to such a point that it will not be drawn back into the intake.

Where electric power service may be interrupted and all service water pumps are motor operated, a reservoir is sometimes provided. It should have storage capacity for about 3 hours at least. Where a reservoir is used, the quality of the water is improved by the settling action in the reservoir.

Where a combination of steam and electric driven centrifugal pumps is used, and there is positive assurance that no complete interruption to pumping will occur, a reservoir or stand pipe is unnecessary.

Where filtered water is used in sufficient quantity, the construction and operation of a filtration plant may be warranted. In this plant the service water first flows into a mixing chamber through a float valve. The total time in the mixing chamber should be about 30 minutes. Where rotating paddles are used, the paddle speed may vary from .5 to 1.5 fps, constantly maintained. Lime and alum or ferrous sulphate in proper proportions are introduced into the mixing chamber near the service water entrance. A floc is formed in the mixing chamber and in the absence of turbulence, the particles of floc grow and are easier to settle and filter out.

After passing through the mixing chamber, the water then passes through a settling basin. The maximum velocity of the water through the settling basin should be less than 1 fps.

The filter units are generally of the rapid sand or anthracite coal type. Rapid sand filters are generally proportioned on the basis of 350 sq ft per million gallons per day. Generally the filtering medium consists of 30 in. of fine aggregate having an effective size of between .35 and .45 mm. The fine aggregate generally rests upon 18 in. of coarse aggregate built up as follows:

Layer No.	Size, in.	Depth, in.
1	1 to 2½	8
2	⅝ to 1	4
3	⅜ to ⅝	2
4	3/16 to ⅜	2
5	3/32 to 3/16	2

Wash water is supplied either by pumping directly or by an elevated wash water tank, the bottom of which is elevated 50 ft. Washing requires about 15 gpm for each sq ft of filter bed area. This rate of flow raises the fine aggregate about 24 in. The top of wash troughs should be dead level about 30 in. above the top of the bed.

Clear water storage capacity is required for optimum operation of the filtration plant. The filters should operate continuously at a more or less uniform rate. Peak demands should be provided for by drawing from the clear water storage basin or tank.

The filtered water may or may not be chlorinated. If chlorinated, liquid chlorine supplied in tanks is generally used.

WATER DISTRIBUTION SYSTEM

There are three principal methods of arranging distribution piping: the single header system, the duplicate header system, and the loop system. There are many possible combinations of these three systems, such as the single header and loop combination, the single header with duplicate branch headers, the multiple loop, the loop with duplicate branch headers, and many other combinations.

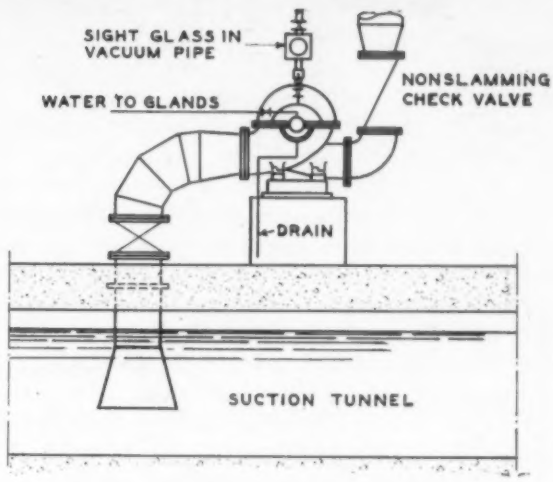


Figure 3 — Pump arrangement.

The single header system, of course, is the most simple and direct system, requiring the minimum of material for construction. It is also the most vulnerable and inflexible system. When repairs, alterations or additions are required, the entire system, or a large portion of the system must be taken out of service. Furnaces must be cooled before such an outage, and during the outage there is no provision for fire protection. In case of a break somewhere in the system there is always great danger that the furnaces will be ruined.

The duplicate header system is more flexible and less vulnerable. There are a number of very satisfactory applications of the duplicate header system, particularly in the use of duplicate headers to furnaces, where the two branches are tied into different parts of a main loop system. However, for the overall plant supply, the duplicate header system has the disadvantage that when alterations are required, or a break occurs, many valves must be operated. In the confusion, the water supply to a furnace may be shut off. Also, when the one header of a duplicate heater system is taken out of service, half of the fire protection is lost.

The loop or multiple loop system is by far the most satisfactory. When properly valved, alterations and repairs can be made with a minimum of consumers being taken out of service. In case of a break only one portion of the loop needs to be taken out of service and this is generally easily arranged. It might also be noted that the pipe sizes in a loop system can be somewhat smaller than those required for the single header system or the duplicate header system.

The minimum pipe velocity should not be less than 2 fps as an insurance against lines filling with mud and silt. The maximum normal velocity in supply mains, headers and main branches should not exceed the following: —

Pipe size, in.	Velocity, fps
24 and smaller	4
Over 24 to 36	5
Over 36 to 42	6
Over 42 to 48	7
Over 48 to 60	8

Where a loop system is used under normal operation with the loop open throughout, the velocity in a 24 in. pipe may be 4 fps. When a portion of the loop is taken out of service, the velocity in the portion of the loop that is still in service cannot exceed 8 fps.

In the planning of a new plant, ultimate plant expansion is always considered. For this reason pipes installed in a new project are, and should be, oversized for the first step. Many of our older steel works which have expanded far beyond the wildest dreams of the original planners are hampered by having an inadequate distribution system.

In the smaller branch pipes, velocities of 6 or 8 fps are satisfactory, but care must be taken that loss of head will not be excessive in the branches. Where quick closing valves are used, velocities should be low because the pressure surge caused by the quick closing of a valve amounts to approximately the pipe velocity in feet per second times 60 psi. For instance consider the water in a pipe having 40 lb pressure and a velocity of 4 fps. If the flow is suddenly stopped by a quick closing valve at the delivery end, a surge of about 240 psi will be superimposed upon the 40 lb normal pressure in the pipe, thus causing a pressure wave, the peak of which will be 280 psi.

A few recommendations for pipe velocities are as follows:

Service condition	Normal max. operating velocity, fps	Maximum velocity fps
Boiler feed	5 to 6	12
1000 lb to 1500 lb	8 to 12	16
500 lb to 1000 lb	6 to 10	12
100 lb to 500 lb	4 to 6	8
Drinking water	3	6

In any distribution system, valves should be so located that any contingency can be met without disrupting continuous service to the majority of consumers. The loop system should always be sectionalized by shut-off valves located strategically around the loop. Each branch pipe should be provided with a shut-off valve near its connection into a main or supply header.

Gate valves are generally used for shut-off purposes while globe valves are more suitable for control or regulating purposes. Control or regulating valves should always be preceded by a shut-off valve. Shut-off valves should not be used for regulation or control, and regulating or control valves should not be used for shut-off purposes.

Figure 4 — Typical filtration plant.

ECONOMIC USE OF WATER

Where water is supplied directly from the primary pump house and is wasted after use, the largest investment is required for pump house facilities, distribution system, and sewer system. Liming, screening, pumping and straining operating and maintenance costs are also highest where such distribution is used.

In many instances, after water has been used by one consumer, it can be used by another consumer without repumping. In many instances, recirculating pumps are used to reclaim water wasted by certain consumers for partial reuse by the same consumers and supply to other consumers. The reuse of water is limited by the allowable temperature rise permissible before wasting the water. It should always be remembered that where water has not been deactivated by removing the dissolved oxygen, the higher the temperature, the more corrosive the water will be.

After water becomes contaminated with suspended matter such as small particles of scale, or by emulsified oil or grease, reuse is inadvisable. There are installations where water is reclaimed from scale pits, but in the opinion of the author the high cost of maintenance of the required pumps and strainers will over balance any savings effected in the primary pump house.

In one plant, water wasted from blast furnaces is being repumped into the service water supply system for use in a group of open hearth furnaces. Where the temperature rise is small, water which has been used for cooling purposes in an open hearth furnace is sometimes reused for cooling the reversing dampers and damper frames.

In many of the recent mill installations heat exchangers have been installed for the purpose of cooling the air supply to motors and other electric equipment. Tremendous quantities of water are required to flow through such heat exchangers because of the small difference in temperature between the air to be cooled and the cooling water. In many installations of such air coolers having low head loss, the water after it has passed through the coolers, can be be used for other purposes without repumping. In one case, practically the entire plant filtered water supply passes through two banks of air coolers before it is used for pickling, cleaning and roll coolant. At one slab mill, after the water has first passed through the air coolers in the motor room and the oil coolers in the oil cellar, it is used to supply the pit furnace tong boshes, scale flushing requirements, shear and various other sprays, and many service hose

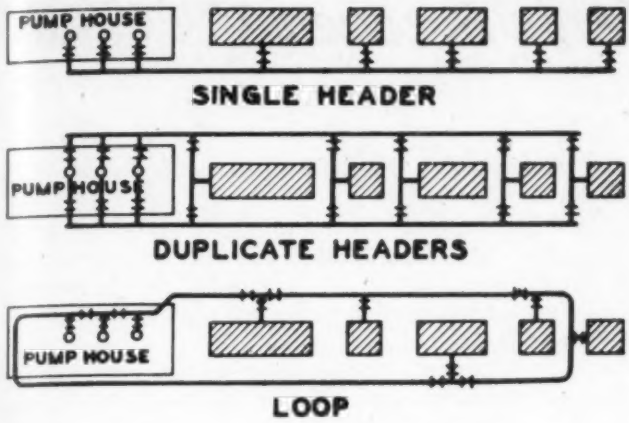
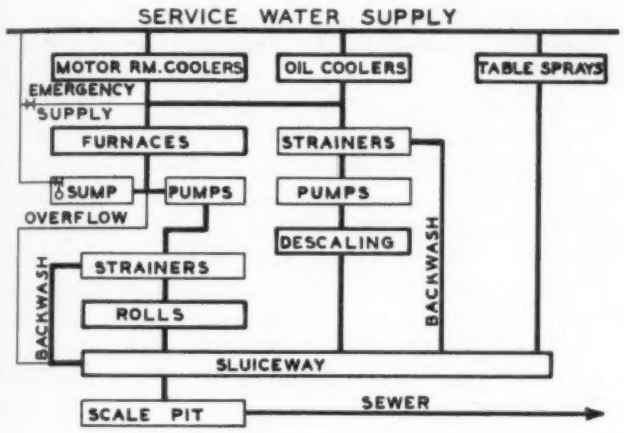


Figure 5 — Distribution systems.

▲

Figure 6 — Typical hot mill flow diagram.



connections used for cooling slabs. At one strip mill and one plate mill, the water, after passing through the air and oil coolers, is used in the cooling elements of the continuous reheating furnaces. It is then repumped into the supply header to the roll sprays at approximately 120 to 150 psi pressure. The backwash from the strainers in these systems is piped to the end of the scale flushing trench, and is adequate for sluicing the scale dropped at the furnace delivery table. Water which has been used for roll cooling is of course used for scale flushing. Water which has been used for the cooling of slip regulators and air compressors is used again for flushing scale.

Recirculating systems are common for cooling bearing jackets. In many cases a small flow of makeup is used continuously and may amount to only a small fraction of the water being circulated to the bearing jackets. A recirculating system is generally used on roll grinders, not to effect the economic use of water but because the quantity of water used for grinding is so small that the sewer flow has less than a carrying velocity. The sewer gradually fills up with roll grindings unless the flow velocity is high enough to keep the sewer clean.

Where temperatures have to be held within a certain range, such as in the water supply for cooling rectifiers for cooling deseaming torch nozzles, recirculating systems are commonly used.

Every possible arrangement should be considered in order to attain maximum economy in the use of water.

The foregoing figures and facts are based upon current practice in actual installations where theoretical considerations were practically applied. The author has had the odd experience of having had to live with, operate and maintain various systems and contraptions which his imagination had devised. It is his recommendation that the entire water supply and distribution system be made as simple and as flexible as possible, and that every designer investigate what can be done with each gallon of water before it is discarded, bearing in mind that he should also determine whether the cost of saving the gallon of water is economically justified.

DISCUSSION

PRESENTED BY

A. G. ERICSON, Chief Engineer, Carnegie-Illinois Steel Corporation, Munhall, Pennsylvania

H. C. COX, Superintendent Coke Plants, Bethlehem Steel Company, Johnstown, Pennsylvania

T. R. MOXLEY, General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio

E. L. ANDERSON, Superintendent Electrical Department, Bethlehem Steel Company, Johnstown, Pennsylvania

A. G. Ericson: Mr. Foight has had a long experience in this line of work, and I think we can take his paper as the basis for deciding any water system in any steel plant.

The thing that might be emphasized here, especially in the Monongahela and Ohio Valleys, is the reuse of water. In most plants, the water is dumped back into the river again after we have cleaned it and limed it and used it once. At Homestead, in the new defense plant area, where we are using in the neighborhood of about 60,000,000 gallons of water a day, the main user is the open hearth plant, where there are eleven open hearth furnaces. Each furnace takes between 2,500,000 and 3,000,000 gallons of water a day. That water is not contaminated in any form, there is no grease or oil in it, and while we are reusing it for valve cooling and so forth, I still think we could make better use of it. I sometimes think that we should dump it right back into the intake well and let it go back again into our system.

The pressures and velocities which Mr. Foight stated were applied in this system, and they have fulfilled all our requirements. The system is very well designed, and we have no deficiency any place in the plant.

H. C. Cox: In our Johnstown plant, we obtain water a little bit differently. Our supply of water comes from a dam up in the mountains, about ten or twelve miles from the plant. It is considerably contaminated by refuse from mines, and we have to lime it. There is enough difference in elevation to produce a pressure of

200 psi in our plant, thus making it necessary to keep the line throttled down considerably.

We recirculate the water as much as possible. Generally, we have all the water we need, especially during the spring and winter months. However, if there is a shortage of rain during the summer we have to economize all we can during the ensuing months. We generally use water first in the surface condensers in the power house and turbo blower station From there it is used in the blast furnace department for cooling plates, etc., in the open hearth department, and some of it is used in the gas cleaning plants before it is finally discharged into the river. It is only when our water supply is very low that we have to resort to pumping water out of the river.

T. R. Moxley: In putting water first through surface condensers and turbo blowers and then into the blast furnace, what temperature rise is experienced before the water enters the blast furnace?

H. C. Cox: Water comes into the plant between 50 and 60 F and varies between 60 and 100 F after passing through the condensers. It varies through the year, and is quite cold in winter.

T. R. Moxley: What do you do with the surface condenser water in the summer months?

H. C. Cox: Although at times it is pretty hot and we have some complaints, we still have to use it. During these months it will run as high as 90 or 100 F leaving the surface condensers.

E. L. Anderson: I would like to supplement Mr. Cox's remarks regarding the water system at our power stations. Due to the limited supply of water, a cooling tower was installed in connection with a 20,000 kw turbine, about two years ago. In addition to this, a 15,000 kw turbine has been operating for the last four or five years on a spray pond. Operation of both these units has been satisfactory.

There is one point I would like to mention, and that is, that after having a cooling tower in operation for a little over a year, we noticed that there was considerable erosion on the circulating pumps serving this unit and the condenser on the 20,000 kw turbine. Investigation showed that the water passing through the cooling tower, which is of the induced draft type, was being highly contaminated due to acids carried in the air from the blast furnaces and coke plant quenchers. It was found necessary to install a separate water treating system on this unit. Treatment was also extended to include the spray pond on the 15,000 kw turbine.

T. R. Moxley: Can you use the water from the cooling towers over again in the turbines?

E. L. Anderson: Yes, we recirculate continuously. Fresh water is used on the oil coolers and on the generator air coolers, and this is put into the system for makeup. The amount of water through the oil coolers and the generator air coolers offsets the loss by evaporation in the recirculating system.

T. R. Moxley: Does your makeup vary much during the different periods of the year?

E. L. Anderson: The amount of makeup required will vary with atmospheric conditions.

Member: How much temperature reduction do you get in the cooling tower?

E. L. Anderson: About 15 degrees.

McKeever DISCUSSION

(*Continued from page 51*)

ence with it to say that it is a panacea for all troubles on commutators.

Paul McKeever: I cannot say for certain just the number of old armatures that have been taken care of in this manner. I know quite a number of new commutators have been applied to the old armatures but just what proportion I cannot answer.

E. L. Anderson: My question did not pertain to the changing of the commutator but rather to applying the seal to an old commutator that has been in service. Do you apply the seal to old commutators, or do you wait until they have run beyond repair and then apply a new commutator with the seal?

Paul McKeever: We wait until a repair comes, and usually it is a repair on the front end, which is a vee-ring or something of that nature. Then we overhaul it and use this process.

E. L. Anderson: Do you remica the commutator when you make this repair or use the old mica?

Paul McKeever: Depending on the condition that the commutator mica is in when we get it. We may replace all the commutator bars, but we do remica quite frequently when the commutator bars are satisfactory.

E. L. Anderson: What I was worrying about was if you use old mica and it is oil soaked and it gets hot, it would allow the oil to seep out and break the seal. I do not believe you will get a good bond between the insulating commutator and the copper on the commutator if there is oil present.

Paul McKeever: In rabbeting that bar out to ½ in. width, you get quite a key in there, and I believe that any vapor would have a tendency to work its way up through the mica itself between the adjacent bars, rather than through the seal.

E. L. Anderson: Is there no chance of the vapor building up sufficient force to break the seal loose?

Paul McKeever: We have never had a seal of this type loosened or destroyed in any manner.

WANTED: Architectural, mechanical, structural and electrical draftsmen. Men experienced in steel mill construction preferred. Have openings for detailers, designers and checkers. Write, Engineering Department, Great Lakes Steel Corporation, Ecorse, Detroit 18, Michigan.

MAINTENANCE AND REPAIR OF

Lifting Magnets

. . . . presenting a number of practices that have resulted in longer and more efficient magnet service . . . .

by V. E. Holtslander

ELECTRIC SHOP FOREMAN
INLAND STEEL COMPANY
EAST CHICAGO, INDIANA

▲ LIFTING magnets are vital pieces of equipment necessary in the operation of a steel plant, yet few people think of a lifting magnet as particularly important. However, they do handle a great quantity of the finished and semi-finished products, as well as practically every piece of scrap preparatory to charging open hearth furnaces, and the efficient and successful handling of scrap is one of the major problems confronting the industry. True enough, a magnet seems to be nothing more than several large, rugged, well reinforced steel castings which from all appearances no one on earth could ever break — a coil wound with magnet wire on the smaller sizes or strap-wound on the larger sizes, well insulated between turns and coils, and also to ground. All parts are carefully machined, sealed, fitted, assembled and firmly held together to form one solid mass, which seems like an ideal and trouble free piece of equipment. Unlike a motor or most equipment, it has no rotating or moving parts, nothing to wear out, requires no lubrication except a little grease on the chains occasionally, and contains (this is very essential) no arcing parts, all of which may lead us to believe that it requires little or no maintenance. However well-founded this supposition may sound, it is erroneous.

I will endeavor to relate some of the difficulties we have encountered, as well as remedies applied and results obtained, through years of operating, maintaining and repairing lifting magnets.

We have approximately 125 lifting magnets, both rectangular and round types in operation in the open hearths, plate mills, hot and cold strip mills, rail mills and various other departments of Inland Steel Company.

We have found there are a number of items which contribute to continuity of operation and efficiency of a lifting magnet, the most important being 1st, the operator; 2nd, the regular inspection program of the magnet and its auxiliary equipment such as controls, cables, cable drums, brushes, connectors, discharge resistors, etc.; and 3rd, the maintenance program employed.

Most magnets are built with plenty of "stuff" in them, and will deliver the goods for a long period of time if handled properly. This is where the operator plays the important part; an experienced operator can carry greater magnet loads continuously, thus increasing the daily tonnage handled in scrap yard service, by keeping the power off the magnet from the time he discharges the load, through the return trip and not reenergizing it until the magnet rests on the pile again, thus keeping his magnet as cool as possible at all times, thereby maintaining its efficiency. If he will allow the magnet to rest on the pile a few seconds with the power

Presented before A. I. S. E. Chicago District Section Meeting, February 8, 1945.

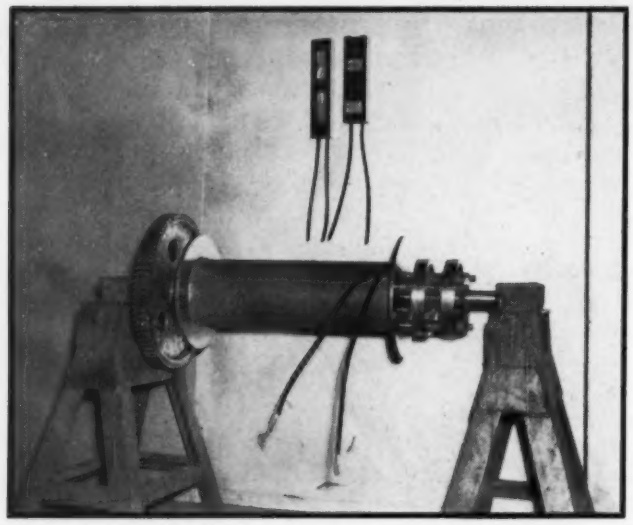


Figure 1 — Male and female connector blocks (on wall) for connecting magnets. Also all-metal welded magnet drum with wide spaced, easily detachable collector rings.

on, allowing the magnetic lines of force to penetrate deeper into the pile, he can carry larger loads. On 65 in. magnets six seconds is considered the required time for the magnet to build up to its maximum strength. When the piles become too small for full size loads, if he will gather the small piles together, making one large pile, and then carry it to its destination, he not only conserves time but also helps the efficiency of the magnet. Most failures of our magnets have been due to breakage of outer pole shoes and bodies. This indirectly causes electrical failures also. The control of this rests entirely with the operator.

In our plant we block the hook to keep the magnet from swiveling and twisting the cable, rather than using a guide. The operator also has much to do with conservation of magnet cables in the manner in which he spots cars and handles the magnet while cleaning up the edges and ends of cars, etc., taking care to prevent pinching the cable between the magnet and the sides of the cars. He may also roll the magnet on the side of cars, allowing the cable to wrap around the steel cables of the crane hook. These operations, we have found, cause most of our magnet cable trouble.

We encounter our greatest breakage of outer pole shoes and bodies, in mould yard and skull cracker service, scrap crane service being less severe in breakage. In skull cracker service we have found that the operator has considerable control of this through the manner in which he allows the magnet to approach the ball, but as the hoist is nearly 100 feet in height, it makes it rather difficult for the operator at all times to observe the exact position of the magnet in relation to the ball. This results in the magnet quite often striking the ball with a terrific impact, striking either the center pole or the outer pole, and the terrific impact causes the breakage. In mould yard service the breakage is due to using the magnet as a battering ram in removing stickers from ingot moulds. This practice has been going on for years, regardless of our campaign to eliminate it.

In the case of rectangular magnets in slab yard service, we have the same condition existing on outer pole shoes, due to the operator using the magnet as a battering ram in straightening and squaring piles of slabs.

On skull cracker service we change magnets at the beginning of each eight hour turn, as the magnets, if left in this service continuously, become too hot to lift the ball successfully. The magnet removed from service is placed on a drying rack and allowed to cool.

We have had difficulties in securing a good connector to easily interchange magnets. We have tried many, but none were entirely successful. We now make up in our shop a connector consisting of two wooden blocks, one having male contacts, the other having female contacts; these hook together and when in service the contacts are completely insulated with the wood. This has proven more successful than any other connector we have used. We have also encountered difficulties in losing center pole shoes, due to studs breaking off or threads stripping. This is rather difficult to overcome. We have also experienced cases of excessive wear on center pole shoes. We now make our own center pole

Figure 2 — Magnet, 65 in. in diameter, with outer pole shoe welded to top cover.

Figure 3 — Magnet, 65 in. in diameter, with outer ring welded to body.

shoes using a special steel rolled in our plate mill. This has proven very satisfactory.

In one of our blooming mills, scrap bloom butts are conveyed to a water-filled pit for cooling purposes. The butts are removed from this pit by 65 in. magnets, the magnet being completely submerged to make contact with the bloom butts, and during the lifting cycles the magnet is usually enveloped in steam from the pit. This is a continuous operation as long as the mill is running. A similar operation is carried on in the scale pit. It is a very severe task for a magnet to perform, and we do encounter difficulties from time to time with water getting into the magnet, regardless of the pains we take to seal and maintain those magnets. We change magnets on these two operations periodically, and the magnet removed is placed on the drying rack, the operation of which will be explained later.

In our plate mill, 29 in. round magnets are used to handle slabs up to 10,000 lb in weight for charging into the furnaces. At times these slabs are delivered from the blooming mill while still red hot, and it is necessary to use a water hose to make a black spot on the slabs so the magnet can lift them. This condition requires frequent changing of magnets to allow them to cool, not from internal heat of the magnet but from the external heat encountered while handling red hot slabs.

On a number of our cranes the magnet drums were of wooden construction, with the collector rings screwed to them. This caused considerable trouble due to poor brush holder assemblies, and when brush troubles occurred, caused arcing and burning of the wood. This caused continual shop maintenance and delays in the field, as well as consuming much of the motor inspector's time. To eliminate this wherever possible, we standardized and made up in our shop an all-steel drum with easily detachable collector rings.

Each magnet carries an Inland number, just as in the case of motors and armatures, and an accurate record is kept on the performance of each magnet. Each field man or motor inspector is responsible for a certain group of electrical apparatus in the department in which he works, including magnets and their controls. This assignment does not relieve him or the other electrical men in the department from answering calls or doing emergency work on any apparatus in the department, but it does give them a fixed responsibility for a certain definite part of the electrical apparatus, and they do go over this assigned apparatus more thoroughly on the turns on which they are working. In this manner we are assured of the magnet, its controls, contact tips, discharge resistance, etc., receiving the same regular systematic inspection and maintenance as do the motors and their controls. We endeavor at all times to have a magnet or two in the electric shop for thorough checking, testing, drying out, tightening up, and overhauling.

Our replacement magnets are kept on so called drying racks, and partial voltage applied, especially during the season when radical temperature changes are expected. We never allow a replacement magnet to lie on the ground. This keeps the magnet from taking in moisture and keeps its temperature practically constant. We believe that moisture is the greatest of all evils, and causes most electrical failures in lifting magnets.

We endeavor to keep the chains well greased to obtain maximum wear. When a chain becomes worn it is always replaced with a new chain; we do not attempt to repair worn or defective chains.

Most of our magnet failures, as previously mentioned, are due to mechanical breakdowns, except in the blooming mill where the water condition prevails. From time to time we have asked manufacturers to increase the size of the outer rings and cases. On our 29 in. magnets

Figure 4 — Tank and connections used to vacuum-impregnate magnets. Vacuum pump (not shown) is located in basement.

one of the manufacturers followed our suggestion, making a special designed outer shoe, changing the thickness of the outer pole shoe from 1 in. to 3 in., the body being increased proportionately. This has eliminated the breakage, and apparently has not affected its lifting power.

When the maintenance man in the field on his regular inspection trips detects a cracked body or pole shoe, the magnet is immediately removed from service and sent to the shop, where it is tested electrically. If found satisfactory, the crack is welded without tearing the magnet apart, and the magnet returned to service. We have in some cases welded the same shoe and body as many as ten or twelve times without failures occurring in the coils. If the magnet when tested shows a ground and the outer shoe is also cracked, we first weld the outer shoe, then proceed to tear down the magnet and make the necessary electrical repairs. This welding prevents the outer shoe from collapsing or loosening the machine fits, so that the magnet can be easily reassembled. Thus the cost of a new outer shoe is saved; in most cases a new outer shoe is broken just as easily as the welded one. We have also encountered cases of loose bolts. This we remedied by welding the outer pole shoe to the

body in a number of places around the magnet. This completely eliminates loose bolts, keeps the magnet tightly sealed against moisture, and prevents movement of the coils inside the magnet.

We have found that, when a magnet is partially grounded due to moisture, and cannot be dried out on the drying racks in the field, it is useless to attempt to dry it out in the shop without disassembling. In these cases, we remove the coils as a unit from the case, remove all old compound, dry out the coils by applying full voltage, clean all fits thoroughly, renew all packings and reassemble.

In these cases the ground is usually found to be caused by moisture or by carbonization of the filling compound due to moisture. We have also experienced considerable trouble with the leads grounding and burning off or breaking inside the magnet. To remedy this we use a braided copper shunt completely insulated with mica.

We have had magnets ground around the center pole of the coil bobbin and this is usually due to the ebony asbestos insulation carbonizing. In such cases we rebuild the magnet completely. In repairing and rebuilding magnets we use mica bond rather than ebony asbestos.

Occasionally we find a magnet which is shorted. In most cases shorted magnets have been due to a breakdown of the insulation between the layers of the coils, rather than between the turns of the individual coils; the short is usually between the two center coils, this being the point of the greatest heat. In these cases the coils are removed from the bobbin, tested, and thoroughly cleaned. The coil bobbin is completely insulated with mica bond, the coils replaced, insulated between layers with mica bond and rebuilt as a unit. We have never found it necessary to rewind individual coils. Special clamps for tightening are put in place and full voltage then applied to the assembled coil unit. As the unit heats, the clamps are tightened in order to mould the mica tightly to the coils. The coil unit is then reinstalled in the case. The external leads and covers are attached and the magnet placed in a drying oven to allow the entire magnet to heat and obtain an even temperature. It is usually left in the oven overnight. The filling compound is heated in a special pressure tank, and when it reaches the proper temperature the magnet is removed from the oven, connected to the pressure tank, full voltage applied, and vacuum is drawn for a short period of time. The compound is then forced into the magnet under pressure, and a constant pressure maintained on the magnet until it cools. The outer pole shoes are then welded to the body and the magnet is ready for service.

We are continuously experimenting with various types of filling compounds as they are developed, but in our opinion the high-temperature asphaltum base compound to date has been the most successful. In all cases we use the vacuum impregnation method of filling magnets.

In conclusion we feel lifting magnets would be a most trouble-free piece of equipment if handled properly and used as a magnet — the purpose for which they were built — and not as a skull cracker, a battering ram or car puller.

DISCUSSION

PRESENTED BY

L. A. TERRY, Superintendent of Power and Electrical Departments, National Tube Company, Gary, Indiana

V. E. HOLTSLANDER, General Electric Shop Foreman, Inland Steel Company, East Chicago, Indiana

FRANK ROBERSON, Maintenance Division, Carnegie-Illinois Steel Corporation, Gary, Indiana.

C. G. DIMITT, Engineer, Carnegie-Illinois Steel Corporation, Chicago, Illinois

R. BLICK, Assistant Electric Shop Foreman, Youngstown Sheet and Tube Company, Indiana Harbor, Indiana

***V. E. SCHLOSSBERG, Assistant Superintendent, Electric and Power, Inland Steel Company, East Chicago, Indiana**

***U. S. Service**

L. A. Terry: I would like to ask Mr. Holtslander how he fills the magnet with compound? I understand you fill it under pressure and would like to know how you keep the compound hot? As the compound cools it shrinks and then you've got to refill it with hot compound.

V. E. Holtslander: The magnet must be heated first. We usually place the magnet in the oven overnight, as this saves time and the entire magnet attains an even temperature. The asphaltum base filling compound is heated in a special heated pressure tank (we use a high temperature compound). When the compound reaches the proper temperature the magnet is removed from the oven, connected to the pressure tank with a flexible metal hose and full voltage is applied to the magnet to maintain its temperature. A vacuum is then drawn on the magnet for a short period of time to remove any moisture which may have collected inside the magnet. The hot compound is then forced into the magnet by applying pressure to the tank which contains the compound. This pressure remains on the tank until the magnet cools, thereby eliminating pockets.

L. A. Terry: How do you determine if you have short-circuited coils in the magnet?

V. E. Holtslander: We have had only two cases of short-circuited coils. By this I mean short-circuited individual coils. Our experience has been short circuits occuring between two coils; in other words, the insulation between the layers of coils carbonizes or deteriorates. To determine whether the coils are shorted, all coils are removed from the bobbin, connected together temporarily, and full voltage applied. Voltage across each coil is then checked, as well as the current the entire series of coils is drawing. This indicates clearly the condition of each coil.

Frank Roberson: I would like to ask what objection there is to the tung oil insulation as distinguished from the asphaltum base insulation referred to?

V. E. Holtslander: We have not used that extensively. We have had a couple of cases where we used tung oil and sand; however, when we attempted to

repair the magnet, it was very difficult to remove the coil from the case with this compound. However, our first thought is to keep the magnets operating efficiently, not to look at it entirely from the repair standpoint. Nevertheless, we had this condition occur in magnets that lift bloom butts from water-filled pits. On one occasion water had entered the magnet and it practically neutralized the compound and returned it to its original base. From that standpoint, it wasn't so successful.

C. G. Dimitt: I would like to ask Mr. Holtslander how many magnets of a given size, say the 65 in. size, does he have in the plant, and how many spares for that size magnet?

Also, with reference to cable take-up, what method is preferred? Is a drum driven by connection to the hoist gearing used, or is a spring driven take-up reel used?

V. E. Holtslander: In the first place, we have no spares. We have several replacement magnets but we do not consider them spares — they are necessary replacements. In our service, the magnets become so hot they become inefficient to lift the ball and we replace them at the beginning of each eight-hour turn. Therefore the replacement magnet is necessary for efficient operation. In the operation at the blooming mill, the magnet is changed periodically so as to allow it to be put on the drying rack and dried out. We have about 125 lifting magnets in operation. That is of all types, round and rectangular; about 50 of them are the 65 in. size.

As far as take-up reels are concerned, we have various types. We prefer the geared type, as we have encountered difficulties with the spring breakage in the spring type drums, in the spring as well as shearing of pins and keys; usually the brush rigging is not built for severe steel mill service. We also had a lot of trouble with the so-called wooden type of geared drum furnished on some equipment. They would dry out, split or break, and the heat would burn the wood from under the collector rings, causing a lot of trouble. We designed an all-steel drum, as mentioned in the paper. It is a welded, geared type drum with easily detachable collector rings, using a large brush and heavy type brush holders, well supported. These changes practically eliminated all drum troubles.

R. Blick: I would like to ask Mr. Holtslander about the insulation on the inner pole and the servicing of that.

V. E. Holtslander: We have usually found, when a magnet comes to the shop grounded, the ground in most cases occurred around the center pole through the ebony board or asbestos insulations, and usually between the center coils. We also found when magnets were in service for some time and the compounds would shrink and the coils become somewhat loose in the case, the ebony asbestos would crack, break, and leak, causing it to carbonize very readily. This, perhaps, was the start of short circuits and grounds.

Several years ago we started to insulate all magnets with nothing but mica bond throughout. We find mica bond does not crack or carbonize as readily as ebony asbestos. This method of insulating has reduced grounded and shorted magnets considerably, however it has not entirely eliminated this condition.

R. Blick: Have you ever riveted the outer ring to the magnet body rather than welding it?

V. E. Holtslander: No. We have been very happy with the success we have had with the welding, as it has practically eliminated our problem of loose bolts and outer rings.

V. E. Schlossberg: Mr. Blick, have you had any experience with riveting you would like to tell us about?

R. Blick: We have had several cases where the original size bolt in the 60 or 65 in. magnet has been ¾ in. Due to the wear we had to enlarge the holes in order to get a tight job. We could not use a larger bolt due to the limits of the recess in the magnet body, so we are reaming the holes and have gone to a 1 in. rivet and we have found it fairly successful.

L. A. Terry: I would like to ask Mr. Holtslander to explain about the type of magnet connectors he is using.

V. E. Holtslander: There are a number of different connectors in use. We have tried many and none have proven too successful. On the screw type, threads would strip easily and if not tightened properly would burn; on the brass split type connector, the fits would become indented or bent, thus making them almost impossible to interchange; on the common bolt hole lug type the time involved to change magnets, tighten bolts, etc., was something to consider.

We then made up a connector consisting of two wooden blocks, one having male contacts, and the other female contacts. The wooden blocks are shaped to receive the copper contacts which are made up so that when the connection is to be made the one set of contacts hook over the other and are pulled down into place. On the female block we use a piece of ¼ in. x 1½ in. copper bar. On the male we use ⅛ in. x 1 in. copper bar. These are shaped to form the hook and have plenty of capacity for high currents. When they are hooked together the wood completely insulates the contacts. With these connectors we use no bolts; there are no threads to strip, and no insulating is required. They are made up in our shop, are inexpensive and really have done a good job. We use them throughout the entire plant, not only on magnets but wherever a connection of similar type is necessary.

Member: Mr. Holtslander mentioned the fact that the motor inspectors took care of the control in the electrical maintenance, but he didn't mention the change in the shoes etc., that is, the bolts connected with the shoes. I would like to know who takes care of that part of the magnets.

V. E. Holtslander: All the equipment connected with the magnet is taken care of by the motor inspector, and the motor inspector on his regular inspection trips inspects the magnet for cracked bodies, cracked rings, loose bolts, poor connectors and so forth. Should he find loose bolts or cracked bodies, the magnet is removed as soon as possible and sent to the shop, where the bolts are renewed as mentioned. We have welded the outer rings and bodies to eliminate loose bolts and that has practically eliminated all loose bolts as far as shoes are concerned.

Recently it has been rather difficult to obtain special alloy bolts, and since we have gone to welding the outer shoe to the body of the magnet, we use a common bolt. By welding the outer shoe to the body of the magnet, it has practically relieved the necessity of bolting. However, we do still continue to use the bolts.

Protection FOR A-c AND D-c *Motors*

. . . . overload relays must be properly applied and must receive frequent and regular inspection . . . . thermal relays require the proper heating elements . . . .

by C. E. Homer, SUPERINTENDENT
ELECTRICAL DEPARTMENT
YOUNGSTOWN SHEET AND TUBE COMPANY
EAST CHICAGO, INDIANA

▲ AT the present time, with the shortage of competent electrical maintenance men, the overload protection of drives is of vital importance. The electrical manufacturers have done a great deal to improve the efficiency and accuracy of overload protective devices; however, the best designed overload relay will not function properly unless adequately maintained.

There are in the main, three types of overload relays in general use today. They are the straight instantaneous type relay, the inverse time relay, and the thermal overload relay. For protection of a-c motors with their high starting current, none of the instantaneous type overload relays will give the correct protection to the motor windings. Therefore, thermal overload relays have been almost universally adopted for the protection of a-c motors.

Most types of thermal overload relays will not stand short circuit currents. Therefore, in every case the thermal overload relay should be backed up either by fuses or by circuit breakers just sufficiently large to stand the normal starting current.

Presented before A. I. S. E. Chicago District Section Meeting, February 6, 1945.

There are three general types of thermal overload relays. The type which uses the bimetal strip as an actuating medium, the type which uses the solder pot or solder film, and the type which uses an alloy that loses its magnetic properties at a certain definite temperature. The general characteristics of the three types of relays are very similar, but the care and maintenance is slightly different with each type.

One very important maintenance point with all three types of thermal relays is to keep all connections on the relay tight at all times, as any heating caused by a loose connection will seriously affect the calibration of the relay.

In the bimetal type our very first consideration of course should be the selection of the right size heater coil for the motor being protected. This will vary with the type of motor, location of starter as to ambient temperature conditions, and the type of enclosing case provided with the starter. The tables that are usually provided with relay heaters do not in most cases consider anything but motor current rating and the type of enclosing case. It is my opinion that the temperature conditions where the starter is mounted remote from the motor should always be given consideration.

Most types of bimetal overload relays have an adjustment to give a range of about 20 per cent above and below the heater rating. This adjustment also makes it possible to adjust for a slight temperature difference between the starter and the motor. Under no consideration should a bimetal strip or the tripping mechanism be bent, deformed, or otherwise tampered with, because just a slight bend in one of the pieces in the relay may throw it entirely out of calibration.

In order to insure proper tripping, the bimetal relay, like any other piece of electrical apparatus, should be kept clean and free from dust and dirt at all times. Very frequently proper care is not given to an overload device due to the fact that it is more or less a static piece of equipment and is operated infrequently.

On the solder pot or solder film type relay a heating element is also used, interchangeable for various current ratings. It also has a slight adjustment to get a tripping point slightly above or below the rating of the heater; thus adjustment can also be used to correct for a difference in ambient temperature of starter and motor. In case the solder furnished with the relay is lost or in any way becomes contaminated, nothing but the particular type of metal furnished by the manufacturer of the relay should be used as replacement. In fact it is usually better in a case of this kind, to install a new solder pot or solder film.

Very frequently in maintenance work, when trouble is experienced on a thermal relay, the door of the starter is left open, the elements are bent, or the relay is blocked. Any of these things, of course, will entirely defeat the purpose of an overload relay. After the correct relay and heating element have been installed, they should not be tampered with under any circumstances. It is much better to investigate and correct the trouble causing the tripping than to eventually change a motor.

Due to the great lag of the motor behind the thermal relay, a thermal relay should not be repeatedly reset without correcting the overload condition, as this will eventually result in a motor failure. I cannot stress too strongly the importance of correct thermal overload relays for a-c motor protection. A great deal of study should be given each application to obtain the correct relay and its proper setting. There are many factors to be taken into consideration in choosing the right type, such as conditions at the place of mounting, vibration, dirt, heat, etc., whether it is designed for hand or automatic reset, and to balance the amount of protection desired against the continuity of operation necessary.

In the field of direct-current motor protection there are many differences of opinion as to the proper type of relay to apply. I believe that most d-c drives at the present time are equipped with either the instantaneous or the inverse time overload relays. They are more satisfactory on a d-c motor due to the fact that with our modern control they can be set closer to the allowable motor current and can be instantaneously reset. However, there is a trend at the present time to use both thermal and instantaneous relays for d-c motor protection. Again, the amount of protection desired must be balanced against the continuity of operation necessary.

The instantaneous type are what their name implies, giving instantaneous tripping when the current reaches the value for which they are set, while the inverse time relay has an adjustable time for tripping through a narrow range.

In the maintenance of either of these types, as with other electrical equipment, cleanliness is first, and after correct setting is determined, it should never be tampered with or changed. The thing that causes most motor failures, even with good protective relays, is the facf that when the relay trips, very frequently instead to correcting the trouble, the relay is set for a higher value, which of course defeats its purpose.

With the inverse time relay where an oil dashpot is used for time delay, the correct oil should always be used and should be kept clean at all times. Most of the instantaneous type or inverse time relays can be made automatic or hand reset. The type of reset desired has to be determined for each individual drive.

Wherever it is possible without interfering too greatly with continuous operation of certain equipment, I favor the hand reset as it makes it necessary for the electrical maintenance man to visit the panel, when he should determine what is causing the overload and correct same if possible. Very often production men, regardless of overload tripping, will continue restarting a drive until the insulation of the motor eventually fails. We all know how greatly the slight increase in heating over the normal heat of the motor can shorten the life of the insulation. That is to say, some overloads, while not causing an immediate failure, eventually will greatly shorten the life of the motor involved. That is why any type of overload relay should be carefully and adequately maintained as to calibration and its ability to kick off the drive when the overload occurs, and no one should be allowed to block the contacts of the relay for any reason.

I believe that whenever a new drive is installed, either a-c or d-c, a very careful load check should be made to determine the actual load conditions and that these load tests should be filed away for future reference. Whenever possible, periodic rechecks should be made on these drives to determine if some overload condition is gradually taking place.

On open type d-c mill boards, dirt is of course a problem with the overload relay as well as it is with the other electrical contacts. Sometimes this dirt can seriously affect the setting of the relay and due to the infrequent operation of the overload relay contacts, dirt may also cause trouble. Here again the selection of the proper type of relay is very important. Some types are provided with a cover so that no dirt can get at the relay.

In summation, the first consideration in overload relays is proper application; second, especially on thermal relays, selecting the proper heating elements; third, frequent and periodic inspection and cleaning of the overload relays to be sure that they are functioning properly and to be sure that there has been no blocking or tampering with the relay elements.

SHAFT CURRENTS MAY CAUSE *Bearing Failure*

. . . . excessive bearing wear and failures may result from stray currents induced in the shaft of an a-c or d-c machine . . . . such currents are easily eliminated or shunted away from the bearings . . . .

by D. B. Hoover, DESIGN ENGINEER
WESTINGHOUSE ELECTRIC CORPORATION
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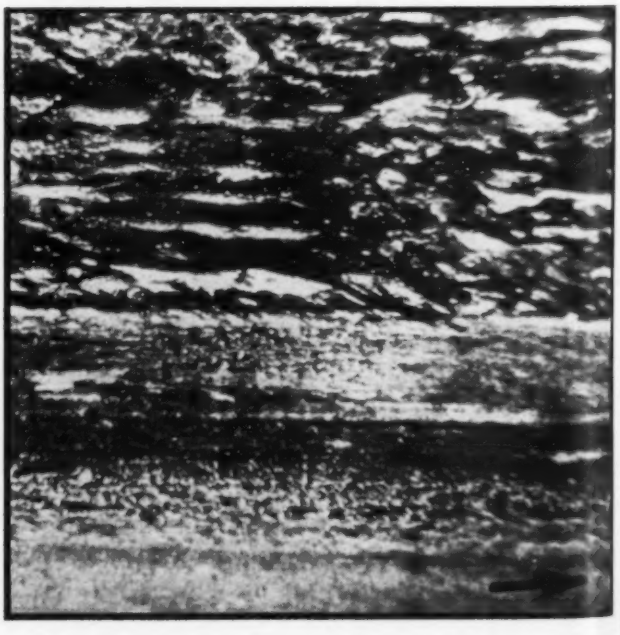
▲ SHAFT currents in industrial motors and generators may cause excessive bearing wear and resultant bearing failure. In most cases current that is present in the shaft must cross the bearing oil film and flow into the bearing shell. This action pits the bearing surface and often the shaft, causing bearing wear and frequently bearing wiping. The rate of bearing wear may be rapid, causing bearing failure in a matter of days, or it may be of a slower nature, causing bearing failure after a long period of operation. Bearing wear is accelerated if the current is large and the loading high.

The surface of a bearing which has had bearing currents is covered with fine pit marks (Figure 1). These pits are often found in bands around the bearing surface, and if the current is very severe the shaft itself will have pit marks.

A simple method of determining the presence of possible bearing currents is to attach a short heavy cable to the bearing bracket or bearing pedestal of the machine, and then touch the other end of the cable to the rotating shaft as illustrated in Figure 2. Presistent electrical sparks between the shaft and the cable end indicate that bearing currents are possible. However, this test in itself will not show if there are bearing currents of sufficient magnitude to damage the bearing. Nevertheless, if the

Figure 1 — Bearing surface which has been pitted by shaft currents. Magnification 54 times.



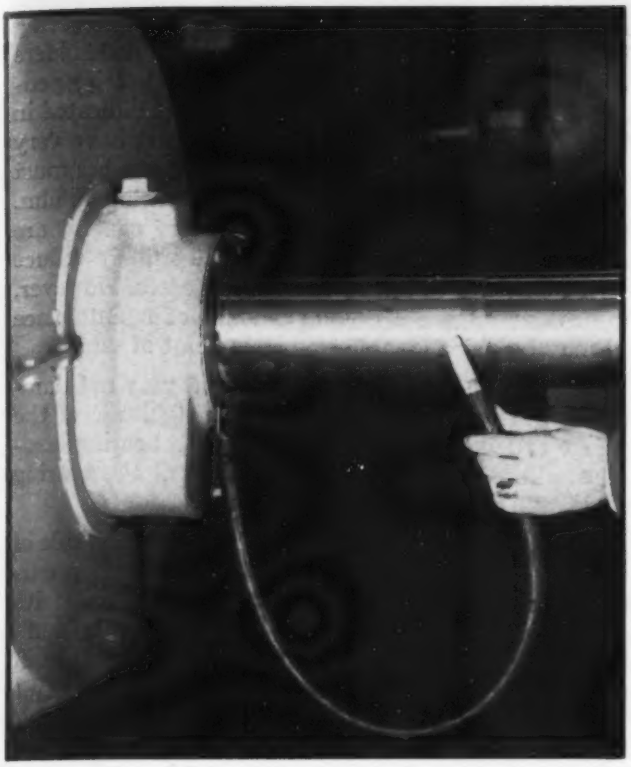


Figure 2 — Bearing currents can be detected by holding a cable with one end fastened to the bearing housing against the shaft of a rotating machine. Sparks at point of contact between cable and shaft indicate possibility of bearing currents.

bearing surface has a pitted appearance and if sparks are present between the shaft and cable, it is nearly certain that damaging bearing currents exist.

Bearing currents may be either direct or alternating, depending on their cause. Magnetic dissymetry of a machine will cause an a-c voltage to be generated in the shaft. This voltage will tend to circulate current through the shaft, across the bearing oil film, through the base and thence back through the other bearing as shown in Figure 3. Bearing currents of this type may be present even in a perfectly designed machine, since manufacturing variations may introduce slight magnetic dissymetry in a machine.

Magnetization of the shaft may produce d-c bearing currents. The method of connecting the series and commutating fields of a d-c machine may produce a magnetizing effect on the shaft of the machine if the load current is allowed to make an uncompensated turn around the shaft. This action is exactly the same as an elementary iron core electro-magnet which has turns of wire about its core. It is possible by proper connection to reduce the shaft magnetization to a small value. This magnetizing effect will cause magnetic flux to pass along the shaft, across the bearing oil film, through the base and thence back through the other bearing. The flux set up by the magnetizing force generates a homopolar d-c voltage in the shaft along the bearing. This voltage, if sufficiently large, causes direct currents to circulate from the shaft through the bearing and back to the shaft. In other words this bearing current circulates locally within the bearing, as shown in Figure 4, and does not flow through the entire length of shaft.

A-c bearing currents may be best eliminated by insulating one bearing, including holding-down bolts, dowels, oil piping and grounded connections. This insulation will break the path of the current and no further

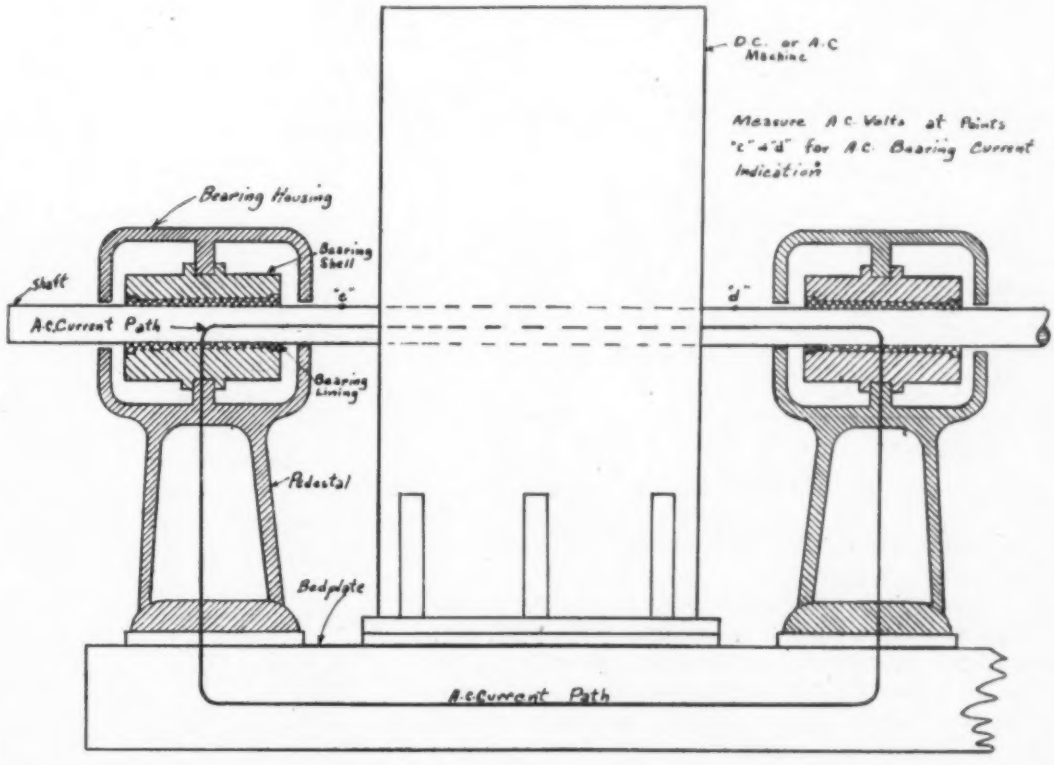


Figure 3 — Path of a-c shaft currents produced by magnetic dissymmetry in a machine.

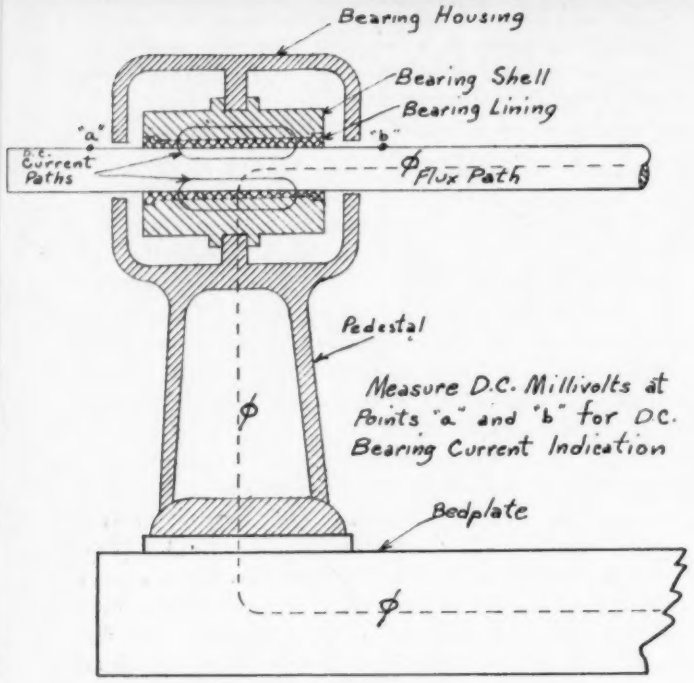
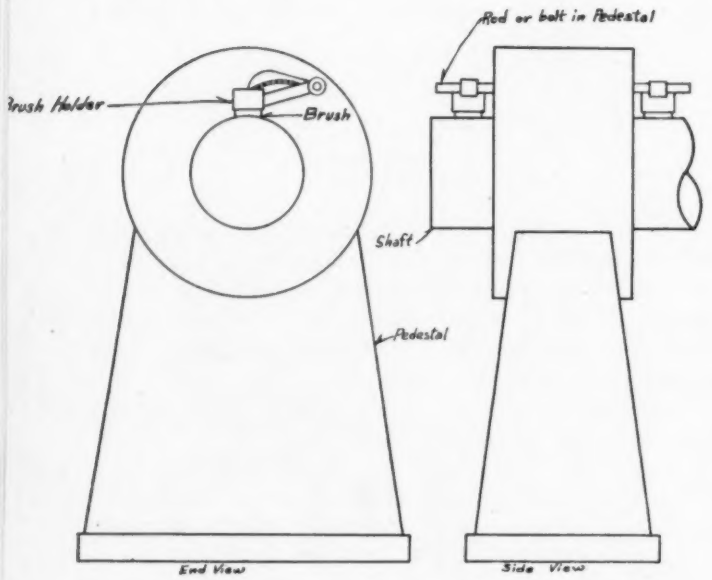


Figure 4 — Path of d-c shaft currents produced by magnetization of shaft.

▲

Figure 5 — A-c or d-c bearing currents may be reduced to harmless values by shunting them out of the shaft with brushes attached to the bearing housing and riding on the shaft.



bearing current is possible if the insulation is kept clean and in good condition.

D-c bearing currents may be best eliminated by reducing the magnetizing force around the shaft. It is recommended that the manufacturer of the machine be contacted in this case. Bearing insulation will reduce the flux and thereby reduce the internal circulating bearing currents. The reduction gained by this method is often enough to eliminate bearing damage.

Both a-c and d-c bearing currents may be reduced by shunting most of the bearing current out of the bearing. This may be accomplished by adding brushholders (with brushes that ride on the shaft) to the bearing pedestal or bracket in a manner similar to that indicated in Figure 5. Brushes for this application must have very low resistance, since the resistance of the brushes must be much less than the resistance of the bearing oil film. Metal graphite brushes with high copper content are suitable for this use. This method will usually reduce bearing currents to a safe value in all cases. However, the brushes require a certain amount of maintenance and may be objectionable from this point of view.

The presence of some bearing current may not damage the bearings of a machine. The magnitude of the damage is dependent on bearing current, bearing loading, condition of the oil, and condition of the bearing and journal surfaces.

The voltage measured across the shaft on each side of a bearing is an indication of possible d-c bearing currents. Usually a voltage of 150 millivolts (measured with a d-c millivolt meter) will not circulate currents of sufficient magnitude to cause damage in a sleeve bearing. If an a-c voltage is present across the shaft of a machine (from a point on each side of the rotor on the shaft inside of each bearing pedestal or bracket) it is evidence that some a-c shaft current may be present. However, it is not possible to take reliable electrical readings of the magnitudes of bearing currents and voltages with ordinary instruments. An oscillograph will give much better results when used with the proper shunts and elements. Even if reliable readings are taken, they are difficult to interpret in terms of possible damage because of the variable factors entering into bearing damage.

Proper maintenance of oil and bearing conditions tends to eliminate wear caused by bearing currents, since a good clean oil film increases the resistance to current flow. This oil film acts as an insulator except for very minute projections on the bearing surface which may press through the oil film. Some machines are originally built with bearings that are insulated, depending on the type of bearing, speed of rotation, bearing load, and the size and rating of the machine. Any insulated bearings should be checked periodically to make sure that they remain insulated. Often mechanical parts which are close to the bearing will be moved and short across the bearing insulation, allowing shaft current to flow. Dirty or poor insulation will cause the same trouble. These points can be readily checked at each inspection.

It is wise to consult the manufacturer of the machine on any cases of serious shaft currents, since he is more suited to make recommendations as to how a bearing should be insulated or what other steps should be taken to eliminate this trouble.

Roller or ball bearings are more likely to have bearing currents and abnormal heating than sleeve type bearings, since the contact between the bearing and the shaft is extremely good. Good contact will allow more current to flow through a given bearing for the same bearing voltage. Also, the high speed rollers or balls in the bearing will cut any flux passing from the shaft to the bearing at a high rate. This induces bearing currents within

(*Please turn to page 78*)

Steel Plant Maintenance

. . . . successful maintenance requires thorough training of personnel, regular inspection and reports, intelligent management of spares, advance planning of jobs, and close cooperation with operating and engineering departments . . . .

by D. S. McLean, MASTER MECHANIC
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▲ THIS subject is one having a broad scope and embracing a multitude of factors. Many of these topics could become the subject for an entire paper. Here, however, only a few of the major factors are to be mentioned with brief comments on each.

Maintenance may be basically defined as the work of keeping plant equipment in good running condition. The war years have given us the unprecedented experience of extraordinary increases in production, radical changes of product, and prolonged production schedules. The definition for maintenance has required a slight alteration. It now reads, in most cases, the work of keeping plant equipment running.

Maintenance is not a necessary evil, as has been the thought in many minds. It should and can be an essential aid to increased production. The better the quality of the maintenance crews, the better the opportunity the production crews have of increasing production and profits.

Serious consideration should be given to maintenance personnel and the maintenance organization. Supervisors should be carefully selected. An error here can only result in costly delays ruinous to production schedules, and in sleepless nights and poorly trained crews. The number of employees required depends upon several factors:

1. The size of the plant.
2. The type of machinery.
3. The continuity of operations.
4. The design of the machinery.

Consider these carefully. A strip mill, for example, where roll changes are numerous and a large amount of assembly work is entailed, and where elaborate lubrication systems and hydraulic spray systems are installed, will require a larger crew than a small merchant bar mill.

Similarly a steel mill will require a larger maintenance crew than a fabricating plant. Continuity of operation is a major factor. Mills which operate continuously usually require more men than those scheduled for a 5 day or 6 day week. This is not the case, however, where a floating maintenance crew is available. Such a crew can be used throughout the entire plant, providing that shut-down period in the various departments can be staggered. This crew serves, as well, as a source of help in the event of a major breakdown. Another advantage is that of providing a good training ground for departmental maintenance crews. The floating crew has for

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its nucleus a group of riggers and ironworkers; introducing new men into this group permits wide experience to be gained by the new employee, as well as giving the supervisors in the various departments opportunity to observe the employee and form an opinion of his worth as a future maintenance man.

In the various departments some division of the department into smaller sections or zones often is an aid in determining the number of men necessary for adequate maintenance. It may be the case that an inadequate number of men are assigned to this work, resulting in poor maintenance; it may be that some employees are not being fully utilized and changes in the duties required of them would assist the entire program.

Delegation of authority is as difficult a problem for the maintenance foreman as is selection of supervisors for the department by the superintendent or manager. Often a good worker, a millwright helper, cannot direct even a small group with good result. To promote him and give him authority over others means a poor millwright is obtained and a good helper is lost. Men chosen for group leaders should be men with a real interest in mechanical equipment. Tinkers, garage operators, gas-station attendants and others claiming to be mechanics do not usually make good millwrights. A love of machinery, a pride in its appearance and performance, and a pride in a job well done mark the real maintenance man.

In training maintenance men in a department an essential procedure should be decided upon — that is, the inspection routine should be definite, the working methods should be clearly understood, and safety practices definitely set down. Every employee should be familiar with these standard procedures and understand that they must be carried out. With this for the basis, qualified men can be depended on to use common sense judgment in meeting any situation which arises.

The ability to decide quickly upon the most effective means of making repairs is often the governing factor on a breakdown. The time of emergency is not the time for consultation and argument. Decisive action is obtained only by correct training methods plus experience. A good practice is to review repair jobs and discuss these with the men. Errors can be pointed out, and methods, tools, etc. sometimes improved.

In order to keep any department even in running condition, inspection is essential. Everyone wishes that the maintenance foreman could foresee breakdowns and do something about it before a delay is caused. No one wishes for this more than the maintenance man himself. His work increases tenfold when trouble reaches the breakdown stage. Inspection cannot be haphazard or lackadaisical; to be effective it must be orderly, systematic and regular. To achieve this objective some form of departmental zoning is required and responsibility for the zone must be definitely established. An adequate number of men is necessary; men cannot be expected to do a job in one area and at the same time inspect another area.

The inspection routine can only be worked out from experience. Some pieces may require weekly inspection, some hourly; these must all be worked into a system of some sort. A check inspection by the supervisors is an ideal method of disclosing errors and omissions. If the check inspection is properly made and the maintenance man consulted in a fair and pleasant manner, oversights can be corrected and the entire system improved.

A daily report from each shift is desirable. It serves a number of purposes:

1. A check on inspection; obviously a bearing failure immediately following an inspection indicates no inspection unless some other factor is involved.
2. A guide for repairs. A foreman would require a phenomenal memory to retain all the items which need attention, even for one week. The major items are usually noted down, but a number of minor items may be missed and not recalled until after the shutdown period. A list of jobs can be kept from these reports which is handy for taking advantage of short delays.
3. A daily report also acquaints the supervisor with the operations which have gone on in his absence. Here the repair man's viewpoint is obtained, how he thinks the breakdown was caused, why he did not get the job done just as soon as he should have, what difficulties he encountered. The variation between this story and the production man's story is often very wide. Acquainting the mechanical supervisor with this information permits him to give an intelligent explanation to the superintendent, when he asks, without the necessity of waiting till that crew returns to work.
4. A report is an ideal way of having information passed on from one shift to the next and being sure that the information has been given. Verbal information is not always given completely and is sometimes forgotten, whereas the report is always at hand.

Reports of any kind are a difficult job for most maintenance men. Dirty hands, lack of time, the feeling of being too closely supervised, and a desire to not implicate operators if possible, all add to the difficulty. A simple log book serves the purpose very well. If the maintenance men are made to feel that a full explanation is desirable, that errors in method or judgment on their part will be fairly discussed with them and that common sense will be exercised in cases of faulty operation, a truthful report can be obtained.

No doubt some feel that perfect maintenance means no maintenance. In my opinion perfect maintenance is the ability to foresee trouble and take steps to remedy the difficulties at a chosen time. This means that equipment records are essential, but do not think for one moment that equipment records can prevent breakdowns. Some sort of card index system is handy for these records. It is desirable to list spare parts, their location, date of installation, cost, weight and other pertinent information on these cards. From the service record shown on the cards, coupled with the results of the inspection reports, replacement repairs can be to some extent scheduled and greater continuity of production operations attained.

This leads to the question of spare parts: how many, how much, and the methods used in making repairs. Dealing with the spare parts question is rather difficult. The problem varies from plant to plant, indeed from department to department. Several factors are to be considered such as:

1. How essential is the department or machine?
   Here enters the possibility of making the necessary parts when needed, which means that $100 or $1000

or more is not lying in idle storage for two or three months or years.

2. What are the probabilities of the particular part breaking or wearing out?
Quite often numbers of spare parts are stored for such long periods that it would appear foolish to have had them at all. However, this is something similar to insurance and the question is largely dependent upon experience and a considerable amount of guesswork. Probably many examples come to mind of parts you have never used, but on the other hand many times parts are not available when most needed. Most often this latter case is met within new departments starting up.

3. The phrase "ready to use" brings out another point. In major departments a spare part should not be considered as a spare unless it is assembled to the point where the least time is required to replace it when trouble is encountered. In one department a bare shaft, spare for one in a certain reduction unit, might be adequate, whereas in some other department the entire reduction unit completely assembled should be required; the determining factors are questions of invested capital, how much is lost by tieing up the machine or department, can the lost production be recovered, and so on.

Storage of spares is a problem upon which there are a wide variety of opinions. Should they be in the department, handy and under better conditions with respect to weather, inspection and cleanliness? Should they be outside where they do not clutter up the department? Should there be central storage so that there is less over-lapping of spares kept by the various departments? Sometimes large amounts are invested in duplicate bearings, oil seals, mill couplings, etc., but of course each department has its spares under its own jurisdiction with this method.

In maintenance work, planning is the essential factor in speedy repairs or installations. This applies not only to running repairs which are found to be necessary in the course of routine inspections, but also to repair work done during scheduled shut-downs. Cooperation with production schedules is the governing factor in all planning, but sometimes production schedules can be altered to suit other conditions.

Regular shut-down periods, say 8 hours or more if possible, once each week are very desirable. Recurring work such as roll changes, mill scale removal, inspection of lineshafts, gear boxes and other inaccessible equipment can then be made. Temporary repairs made during operation can be taken care of and routine replacements, shown necessary from equipment records, can be made.

Planning is not something which is done the day before the shut-down nor after the repair work is started. It is a continuous process high-lighted by occasional conferences with production heads and maintenance shops, so that a mutual understanding of the various problems involved becomes possible and more effective work is done. Planning of this nature lends itself to flexibility and cooperation becomes easier. Instances of two or more departments shutting down at the same time for repairs, with expeditors and maintenance foremen competing for shop and repair crew services, can be lessened; repair shops and crews are not suddenly overloaded beyond capacity.

Modifications usually are made on the repair program as a result of these discussions; some items are added, some left over. Next comes the work of assigning the jobs to various crews, and here, further modification may be necessary due to shortage of men or other circumstances.

It is usually advisable at this stage of the planning to check over the possible spare parts which might be required. Occasionally, in spite of good records and good expeditors, one may find some job cannot be done due to some part not being available. An alternative procedure may suggest itself and preparations be made for this. Again, the time for this sort of planning is before the job is started.

Fairly accurate estimates of job time can be made, starting-up time predicted, and with good planning and adequate supervision these jobs can usually be held to a schedule. Naturally, cooperation of all departments is required; transportation facilities, shops and labor crews must be available for success.

This discussion on repairs brings to mind the question of locating certain machine shop equipment in each department. A small drill press, shaper, lathe and a good hydraulic press often are useful for small jobs. Transportation costs and time are saved, as well as shop time.

Lubrication is another phase of maintenance work. The days of tallow, common engine oil and ordinary black oil for practically every application, are passed. Lubrication has not only gone through the study stage, but has become a highly technical profession requiring wide experience and knowledge. The advent of roller bearings to replace bronze, iron or babbitt applications, and higher speeds and greater loads have called for concentrated investigations into the lubrication problem. Oil companies and oil consumers have worked toward improved lubricants, improved application and a more universal knowledge of the task performed by a lubricant.

We have all heard the words "burned out, lack of oil" but we still have a need to understand that some of our equipment is burned out not through lack of oil, but through use of the wrong lubricant. This phase of the problem is a little difficult because in some cases we are getting fair service from a given unit and do not realize that longer life is possible.

In any large plant lubrication costs are a considerable item in the total maintenance costs. Suitable systems for grease and oil materially reduce consumption in comparison with hand application methods. In addition, more positive lubrication is obtained with a smaller number of employees required for the work. Well designed machinery units, with enclosed gears, bearings and shafts, give longer life with reduced lubricant consumption. This factor of longer life attributed to better lubrication is difficult to show as dollars on a cost sheet due to the scarcity of performance records on old style equipment. A study of lubrication in any plant will result in better efficiency due to decreased wear, lower consumption, and lower overall maintenance costs. The best lubricant, the best oil or grease system and the most conscientious employees cannot, however, compete against mill scale, water, poor design and faulty ma-

chine shop practice unless these factors are properly controlled and their importance appreciated.

This brings us to the consideration of design and its significance to the maintenance man. We have heard mechanics say "If the fellow that designed this could only be in here trying to fix it he wouldn't design another one this way." Often that is the case. Designers in their desire to make a workable machine often overlook the fact that at some time it must come apart and be repaired, that some one will be waiting for its return to production and someone else trying to repair it. This results in changes being made on many pieces of equipment after we encounter the grief, but often a remedy is not possible then, whereas an improvement could have been made originally.

An excellent procedure is that of permitting qualified maintenance men and production men to look over new designs while they are still on the drafting board. Another is that of having members of the engineering department go out into the plant on visits to maintenance jobs where difficulties due to design are being encountered. This enables the engineer to have a better insight into the operational and maintenance problems, and the maintenance man to eliminate some of his possible future troubles. Quite often the maintenance man's suggestions are worthwhile and on other occasions he can more readily understand why he cannot have just the particular design he thinks he would like.

Since profit is the primary motive in all production processes, costs are an important consideration. Departmental maintenance costs, i.e. the labor for maintenance in the department, is fairly stable once an organization has been built. Fluctuations are due to the use of extra labor in the performance of some specific job. Obviously, if some work which we customarily think of as shop work can be done in the department and yet not sacrifice other work such as inspection or current repairs, some reduction in overall cost is achieved.

For the sake of records and proper proportioning of expenditures, a system of work orders and charge accounts is necessary. The extent to which this is carried will depend upon the result desired. For a close check on maintenance costs on small units in a large mill a finer division of accounts is necessary than if costs are apportioned on a broader basis.

A monthly cost sheet based upon these various charge accounts, to which all labor and materials used to maintain the various units are charged, will immediately show up any large discrepancies. At times large expenditures are required for the purchase of a spare part or parts which, if included on the common accounts, would appear considerably out of line. Therefore, to prevent a more or less continual explaining of these figures, a second set of accounts is useful. In our case these are termed AK accounts. If a supervisor sees his regular account on a certain piece of equipment out of line, he can consult the AK list and see if some major purchase has accounted for the increase. These accounts are of course still included in the production costs but may be, if so arranged, proportioned out as in an installment plan.

There remains, however, one other phase of cost procedure. This is the provision made for the purchase and installation of large units of equipment which may either be entirely new to production equipment or a replacement for a large existing unit which has depreciated to the extent that economical maintenance is impossible. Such expenditure usually comes from capital reserves set aside for this purpose.

For these accounts and to some extent for the previously mentioned accounts, fairly accurate estimates are desirable. Obviously, well kept records, detailed planning of the methods to be used in making installations or repairs, and accurate scheduling of the work are all of great assistance in making such estimates. Usually it is necessary that those in charge of maintenance departments be consulted in making such estimates, and for this reason it would seem advisable that maintenance foremen should be acquainted with cost figures.

Maintenance costs can quite easily get out of line without being noticed for some time unless a close check is kept. Sometimes a piece of equipment could be more economically replaced than continually repaired. This fact is overlooked in many cases unless a regular record is kept right out in the plant where maintenance supervisors are familiar with their costs.

Hoover PAPER

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the balls or rollers themselves, causing overheating. Therefore, the allowable amount of shaft current or flux is smaller for roller or ball bearing operation than for sleeve bearing operation.

There have been a few cases of bearing currents caused by an external source. Widely spaced buses carrying large direct currents can set up a strong magnetic field which may cut the shaft and thereby induce a voltage in the shaft. This in turn can generate bearing currents. Closely spaced transposed buses will cure this condition. However, it may be necessary to demagnetize the shaft and surrounding structures when the new transposed, closely spaced bus is installed to eliminate the effects of old residual magnetism. Shunting brushes, previously mentioned, will help prevent damaging currents in the bearings.

A grounded coil on the rotor of a machine may cause current to flow through a bearing. Periodic insulation resistance readings on each machine would detect this condition, possibly before any damage materializes.

Ground currents flowing through the foundation of the building may flow up through the parallel current path formed by the bearings and shaft of the machine. A low resistance foundation or grounding cables would help remedy this type of trouble.

In general, bearing currents may be generated by many sources. The best procedure to follow is one of elimination. Eliminate each possible source as the investigation proceeds. First, make a complete bearing inspection and then check the machine, using the sparking test. Investigate the possibility of a-c or d-c bearing currents generated by the machines themselves and eliminate or remedy this if required. External causes should then be looked into if necessary. However, this type of trouble is very rare.

Maintenance Symposium-

by J. A. Shimmin

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Maintenance

by J. A. SHIMMIN

▲ MAINTENANCE, like taxes, is always with us, and all industry is becoming more and more maintenance conscious. For a good many years, maintenance was looked upon as one of the necessary evils in the life of any piece of equipment. Failures were bound to occur unless certain things were done during the normal course of machine operation. There has always been a tendency to perform these jobs with a lick and a promise.

The maintenance of boilers, pumps, turbines, motors, piping, heaters, furnaces, cranes, electrical controls, transformers, mills, and all the other various equipment is a recurring, everpresent, endless job. If we do not do what maintenance should be done today, there will be just that much more to do tomorrow. Today, it is a simple job; tomorrow, it is another story. Tomorrow is the day when brickbats fly, and the air is incensed with strong words.

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The attitude that maintenance has been a necessary evil can be blamed to some extent on the maintenance men themselves in failing to present a planned maintenance program. Most maintenance organizations grew up as a gang of fixers and repairmen. However, we must not overlook the fact that some little part in fostering this hit and miss type of maintenance can be credited to the design and layout engineer who built the plant and machine with so little regard for accessibility for maintenance.

The very nature of maintenance work seems to breed a courageous spirit and a dogged determination to cure the ills which have been considered inherent in machines and equipment.

War has increased maintenance difficulties, as plants are worked harder and maintenance staffs are numerically weaker. During these past few years, most of us have not had manpower enough nor machine downtime available to do a real job of preventive maintenance.

Maintenance is becoming more and more a science with some art intermingled here and there. Successful maintenance consists of two elements — when and how. To those who know when and how can be attributed much of the successful outcome of this war.

Operators and management are becoming more appre-

ciative of the problems of maintenance, and maintenance men are becoming more conscious of the effect of overall cost of maintenance upon final product cost. The cost of maintenance is certainly as much a final cost as the cost of any raw materials entering into the end product. One of the problems of maintenance is to reduce cost of maintenance. By so doing, we will decrease production costs and increase production. Increased production will come from the mental attitude of the machine operators when they have machinery in perfect operating order.

We can attain this sort of maintenance, in a large measure, by (1) a well-organized program of planned maintenance, (2) an adequate staff of trained maintenance personnel, (3) properly trained machinery operators, (4) methods and standards applied to maintenance, and (5) cooperation between maintenance, engineering, and operating groups in getting proper plant layout and equipment designed with the thought in mind of minimizing maintenance.

Mechanical Maintenance IN STEAM-ELECTRIC GENERATING STATIONS

by **G. A. PORTER**

▲ THIS paper is limited to maintenance performed at the Delray Power Plant of The Detroit Edison Company. I would like to choose several of the essential materials used in power generation and take each one individually through the power house and give some idea of the maintenance problem involved in the handling of these materials.

Few people realize the enormous amount of coal used. We use approximately 3,000 tons of coal daily. The coal is delivered by boat during the shipping season and by rail in the winter. This large quantity of coal is handled at the dock with a dragline bucket, operated by a winding machine. The coal must be loaded into cars, weighed and delivered to the power house, or to stock in the yard.

The maintenance of yard equipment is of a minor nature. The car tipper, conveyors and belts require little maintenance except good operating care. Conveyors and belt idlers are lubricated weekly. The belt joints are examined daily to anticipate failure, and the necessary repairs are made before it becomes an emergency. The winding machine at the dock is overhauled each year in the off-season. Our experience has taught us to carry the proper spare parts at all times. The coal distributors in the bunker room require little maintenance, but occasionally chutes, worn by the cutting action of the coal passing over the metal, must be replaced or repaired by patching. We have duplicate sets of equipment from the coal-unloading house hopper to the bunker in the bunker room. The breakdown of any one part of the equipment does not prevent coal going to the bunker, but it does slow the handling and time is important. So, it behooves us to keep all coal-handling equipment in good condition.

The coal from the bunkers feeds by gravity to the coal spreaders in front of the stokers. This coal is burned on a single-ended stoker at the rate of about eighteen tons an hour. It requires good operation on the part of the firemen to keep the fuel bed moving evenly at all times to prevent exposing the iron and subsequent burning of the stoker castings. However, it is asking too much to expect the burning of stoker iron to stop completely. Every time a furnace is burned out, there is iron to be replaced. The stoker repair foreman is supplied with a chart-plan of the stoker layout on which he marks the burned iron and the iron replaced on each burnout. A study of these charts helps us to decide what castings might be helped by redesign to prevent constant failure. The records of all burned iron are kept and the cost of iron burned per ton of coal burned is computed and published yearly. Our cost at one time was as high as twelve cents a ton; at present it is three and one-half cents a ton.

The ash from this coal, which amounts to about 300 tons daily with the present coal, goes through the clinker grinders to the pit. Railroad cars are spotted under the ash pit doors which are dumped twice daily. The ashpit is lined with concrete, and this occasionally has to be repaired and the steel protected with paint to prevent corrosion. The hydraulically operated ashpit doors require lubrication and packing care frequently.

The combustion of the coal requires an enormous amount of preheated air supplied by two forced draft fans. These fans require little in the way of maintenance, but are examined yearly.

The gases given off in the combustion of the coal go through an alloy steel superheater which is a network of tubes and requires cleaning three times in every twenty-four-hour period in order to keep the induced draft fan power down and to carry the rating required on the boiler. The telescopic soot blowers which are used on this job require considerable maintenance. The packing is difficult to hold and the mechanism of this type of blower is so compact that it requires almost constant care to keep them in operation. The blower is completely overhauled annually.

The gases leave the superheater to go through an economizer where the boiler feedwater is heated before entering the boiler drum from about 400 F to 525 F. Here, again, the accumulation of scale and soot on the tubes must be cleaned at regular intervals throughout the day. This job results in considerable maintenance, due to cutting of economizer tubes by steam used to remove scale and soot. These tubes are worn quite thin and must be rebuilt by welding. In some cases, protective pads are welded on the tubes and renewed when they are worn out.

The gases then go through the air preheater, through the induced draft fan and out the stack at about 325 F. The maintenance problem on the induced draft fan is constant. Every time a boiler is off the line, a certain amount of welding must be done on the blades of the fan, and the fan must be then rebalanced before going

into service. The life of the blades may be anywhere from two to four years, after which the fan must be entirely rebladed. We carry several sets of blading in stock at all times. We do well when we reblade a fan in a period of five or six days.

Let us consider the boiler proper at this time. It is required by the city and by our company that every boiler be completely inspected internally and externally every year. This means the boiler must be drained and opened up. The main drums are inspected for cracks, corrosion, etc. The superheater drums and side wall headers are all opened and inspected. Then all drums and headers are cleaned by washing or scrubbing. All tubes are turbined to remove any scale which may have formed. The drums are painted with a protective coating. The city and the insurance company boiler inspectors make their inspection just before the drums and headers are closed up and tested hydrostatically. On the annual inspection, the boiler repair foreman is given a sheet with the list of all inspections to be made, covering all motors, fans, instruments, power drives, reductions, safety valves, etc. It is his responsibility to see that all inspections are made, and the repairs and inspection comments recorded. He also has the workman who does each job sign for it.

The steam from the boiler is delivered to the turbine through a carbon-molybdenum pipe line of welded construction. The steam does its work in the turbine and passes to a surface condenser and into the condenser hot well. Attached to the hot well are two boiler feed pumps connected in parallel. One is electrically driven with a 1500 hp motor; the other is turbine driven. The motor driven pump, being more economical, is normally operated. The steam pump is a stand-by. Boiler feed pumps in modern plants of high pressure and temperature are a problem. The pump normally delivers about 660,000 lb of water per hr at a pressure of 1100 psi. The serious problem is interstage leakage, causing cutting of the interstage seal and resulting in loss of pumping power and efficiency. We normally run a weighed water test on a new pump and plot a curve of pump output against motor input. Then, from time to time, we check the performance of the pump in the same manner and compare the curves. From experience, we plot a curve which we call the upper limit of motor input. When we approach this curve, it is time to overhaul the pump. In overhauling the pump, the eroded surfaces are rebuilt with welding wire and either hand finished by grinding and filling, or machine finished if the repair is sufficiently large. Occasionally, the shaft protecting sleeves, wearing rings, balancing rings, and shaft packing sleeves have sufficient clearance that they also must be replaced. We carry these spare parts in stock, together with a completely assembled pump rotor.

The storage capacity of the modern boiler is comparatively small and if the flow of the boiler feedwater is interrupted for any reason, the boiler would be without water in a few minutes. Hence, the anxiety over boiler feed pumps.

The boiler feed pump discharges through a series of feedwater heaters where the temperature is raised to approximately 400 F. These heaters occasionally have tube failure and tubes must be replaced. The tubes also become fouled and must be wire-brushed or chemically cleaned periodically.

From the heaters the water goes through a carbon steel pipe line of welded construction to a feedwater regulator which automatically supplies the demand of the boiler at the different loadings. The regulator valves do a good job of supplying the water in the proper amount, but the valve body is subject to corrosion or erosion in some cases. We do not know, as yet, just which it is — perhaps a combination of both. At present this is another problem we can repair but are not able to stop. We usually remove the worn part of the valve body, build it up to its original thickness by welding, and then weld the piece back into the valve body. We also carry spare valve bodies in stock. In an emergency this valve can be "cut out" and the boiler fed through a by-pass line by hand until such time as the valve body is repaired. This valve is inspected every annual inspection of the boiler.

Now, we have the water through its cycle. Let's consider the precautions taken in an attempt to make the water safe. Daily water samples are taken from the suction to the boiler feed pump. The oxygen content of this water is determined and kept as low as possible. A reading of 0.05 cc per 1,000 cc is high in our plant; normal is about 0.025 cc per 1,000 cc. Daily samples of water from the same source are taken and the pH value determined. We try to keep this above 8. Weekly samples of the boiler water are taken from the boiler blowdown and the pH determined. This water we try to keep about 11.0 to 11.2. Daily conductivity tests of steam, river water, and condensate are taken to check for tube leakage in condensers. The boiler feedwater is treated weekly with sodium hydroxide and disodium phosphate.

River water, which is used throughout the plant as a cooling medium in the condensers, oil coolers, etc., is treated with chlorine to prevent fouling of tubes in condenser and coolers. The water is also screened to keep out the debris. Maintenance of screens is minor and requires an overhaul only after a period of five or six weeks.

Finally, we come to the main turbo-generators and the auxiliary turbo-generators. These machines are completely dismantled every third year. This period was determined as a result of the combined experience of our company and the manufacturer. On an overhaul, the turbine rotor is removed from the casing and all blading of the wheels and diaphragms examined for corrosion, erosion, deposit, cracks, etc. The last two wheels of the turbine and the turbine casing bolts are magnafluxed to determine if any hairline cracks, too small for visual observation, exist. Photographs are taken for record when exact measurements are difficult to take.

Shaft packings and diaphragm packings are examined for rubbing or wear. Bearings and couplings are examined, and the alignment between generator and turbine is checked for accuracy. Wheel clearances are checked with the manufacturer to see if they have changed in any way.

The main and auxiliary oil pumps are examined for wear. The governor and its linkage are examined for wear. The high- and low-pressure water runners are dismantled and examined.

Examination results and repairs made are all recorded in an overhaul inspection report and filed for reference.

During the overhaul of main and auxiliary turbogenerators, all auxiliary equipment which goes to make up the unit is dismantled, examined, and repaired where necessary. This includes the circulating pumps, hot well pumps, lift pumps, air ejector, condensate pumps, stage heaters, oil coolers, etc.

Electrical Maintenance

by JOHN STEWART

▲ ELECTRICAL maintenance in plants can be roughly divided into two classifications: preventive maintenance and the repair of an actual breakdown. We all know what is meant by preventive maintenance; the words are self explanatory.

Until now electrical equipment on machines has been of secondary importance to the machine tool engineer and designer, and starters, etc., have been stuffed into undersized cubby holes in the machine bases with no thought given to maintenance. Utility has been sacrificed for streamlining. The practice of placing electrical equipment too close to the floor where it could be damaged by trucks and other conveyances, or in some part of the machine where it was liable to be splashed by oil, cutting fluids or coolants, or exposed to vapors which would cause damage, has come to an end.

Preventive maintenance used to start after the machine had been put into operation in the plant but engineers have now taken it back to the engineering and designing of the machine.

No matter how small the plant, preventive maintenance pays. In your own home you oil the washing machine and vacuum cleaner and if you see sparking you check the commutator and brushes. Why? To keep them working for a longer period without breakdown — to lengthen their useful life span. That is the whole object of preventive maintenance. Can anyone imagine a smaller plant than a washing machine and vacuum cleaner? That is one extreme; now let us go to a great distance in the other direction, to almost the other extreme. The Plymouth plant is served by seven primary cables from the Edison substation, a distance of about ¾ mile. Recently one cable "blew up." We switched the load, cleared the line and by means of a high-potential test located the breakdown. It was between manholes under the railroad tracks where we unload all our fluids: gasoline, kerosene, enamels, butane, etc. The two manholes were about 200 ft apart and the fault occurred 40 ft from one of the manholes. We swabbed the duct at this point and the chemical analysis showed a very alkaline condition. This, the chemist informed us, would have a deteriorating effect on lead. It was reasonable to suppose that the other six cables would be subject to the same hazard, so that presented a problem. The Edison engineers agreed to pull out the other cables and replace them. At the time that was out of the question, so it was decided to flush out all the ducts between these manholes. At first the fluid came through dirty, ruddy and muddy, so we kept flushing until the water ran clear. If that alkaline condition has not been entirely cleared it has at least been reduced to the point where it should not have any further bad effect on the lead. That operation cost $48 but a cable failure during production could easily run into a loss of thousands of dollars.

The size of the plant and type of manufacture will determine the preventive maintenance policy. Larger plants may have two, three or more men checking equipment. Conditions such as dirty and dusty manufacturing, or other unusual condition such as excessive heat or excessive dampness, would determine the frequency of the checks. Checking equipment is sometimes an ideal job for a man who has been ordered light duty.

There is one point I would like to stress: — When a report of an unusual or questionable condition is made don't fail to act on it; otherwise, the man who makes the report will become discouraged or disgruntled and think that there is no use of making reports when nothing is done about them.

Probably the first rule in preventive maintenance is cleanliness. Of course, some motors and other equipment work under adverse conditions, so let us say electrical equipment should be kept as clean as possible at all times.

One elementary and simple form of preventive maintenance is, of course, oiling and greasing. Oil bearings should be checked frequently but that is not necessary with greased ball or roller bearings. It is our practice to grease all motors once a year and for our type of manufacture that seems to work very well. Sometimes as much damage can be done by improper or over greasing as by neglect to grease at all. The average electrician will take out a grease plug, force in a lot of grease, replace the plug, and consider he has done a good grease

Figure 1 — On this machine the controller is approximately 6 in. from the floor making it necessary to lie prone on the floor to test this starter. This position is difficult and dangerous. Also, inner anchor bolts of the motor are difficult to reach, doubling at least the time necessary for motor changes.

job, when in all probability what he has done is to force a lot of grease into the windings, which can cause damage, and to leave the bearing under pressure. Both plugs should be removed and grease forced in at one till it comes out free and clear at the other. Before replacing the plugs, particularly on high speed motors, the motor should be run for a short period. This expels excess grease and relieves any pressure on the bearing. Then replace the plugs and you have done a really good job of greasing and therefore a good job of preventive maintenance.

In most plants there is at least one transformer. No definite rule can be laid down about how often the oil should be dehydrated and clarified. This has to be determined by load, heating and other conditions such as changes in temperature, etc. The transformers in our plants are done every eighteen months to two years and we have not had a transformer breakdown in the sixteen years we have been operating. There are eight power banks and five lighting banks, and that seems to me a pretty good record. Oil circuit breakers should be checked and oil changed when necessary.

Motors and generators should be checked for excessive grease, dirt, overheating and excessive vibration. Slip rings, commutators and brushes should get special attention.

Metal dust and splashing from oil, coolant or cutting fluids are amongst our greatest troubles. All cabinets and control panels should be kept shut and the practice of machine operators making panel boxes receptacles for aprons, gloves, lunches, milk bottles, etc., should be banned. That is good preventive maintenance and also means safety for the operator.

Wiring in panels — in fact, all wiring — should be checked. Conduit or connector entrances into boxes or panels should be checked, particularly where there are concentric knockouts. All unfilled knockout holes should be plugged. Overload devices should be checked. It is surprising how many times we find machines overfused or overload thermal devices much too heavy. No one ever does it but we find it all the same. To get a machine going any sized device convenient is used with, I suppose, the good intention of fixing it later with proper size — and later, like tomorrow, never comes. Sometimes temporary wiring is run with the same good intention and is never fixed, and this can be troublesome. Let us consider for a few minutes maintenance as it is generally understood, that is, getting equipment back into operation after breakdown with the least possible delay. No hard and fast rules can be laid down for this that would cover all plants. The supervisor in each plant has to establish a system which he considers is best for that plant. Let me tell you how we operate. The plant is ½ mile long and at present there are four stations besides a central station or the "shop." These stations usually have two men and are distributed throughout the plant. Each has definite departments or districts to cover. The trouble call comes into the central station or shop. It is written up in triplicate on a mechanical trouble order and time stamped. The clerk pushes a switch for the particular station wanted. This operates a light or lights in the station and district. The central office is called by phone. The machine equipment number and location, and sometimes the actual trouble, are

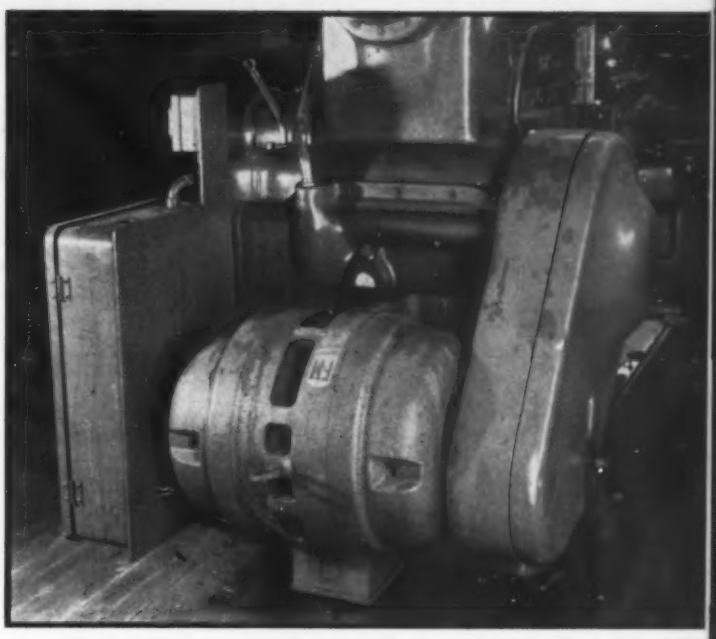
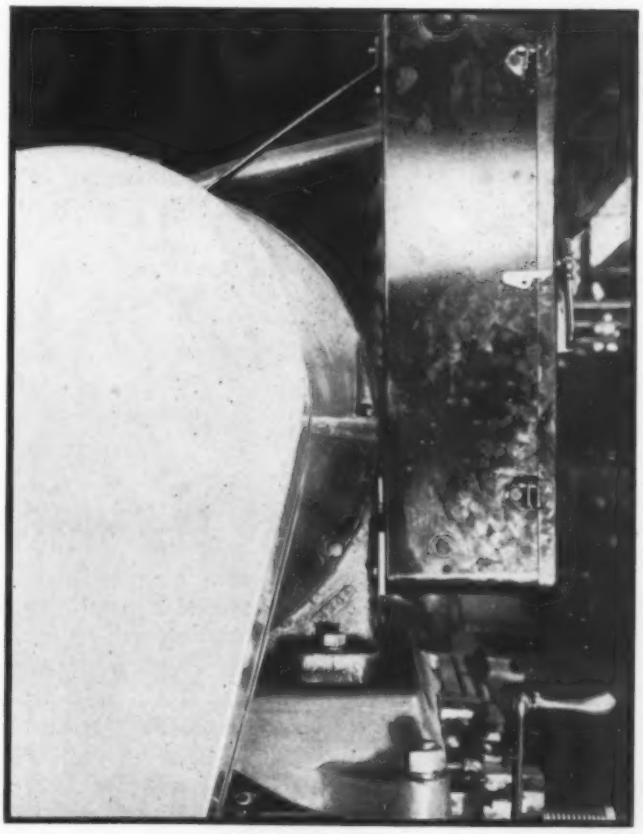


Figure 2 — This control panel is also only 6 in. from the floor and stands out from the rest of the machine. In this position it is in danger of being clipped by any passing truck. Also, motor bearings cannot be changed without removing controller or motor.

▲

Figure 3 — The bottom of this controller is fastened directly to the motor frame, while the top is supported by a bracket from the top of the motor. In case of motor change the controller must be removed and the replacement motor bored and tapped to reinstall the controller.



given to the station and that is entered on a pad at the station and time noted. The trouble is fixed, time again noted on the pad, and central station is immediately called, giving the OK and the nature of the trouble found on the machine. This is noted on the back of the ticket and the time stamped on back. You might ask why the production foreman doesn't get the man at the station and eliminate all the phone calls and paper work. The foreman sometimes does that but he still phones in the trouble call and states that the man is on the job and then there is no need for central to call the outlying station, but the man phones in as usual with the OK when the job is completed. To keep the records straight it is necessary to have the paper work. If numerous calls come in on any machine that machine should be checked.

Again some superintendent will call and say that there has been a call in for one hour and nothing has been done about it. A check usually shows it has been about seven minutes, which can be proved by the tickets. Another point is that down-time on a machine has to be charged to some department. If production is behind schedule, to cover up, the production department could report that the machine had been down, say, two hours because of electrical trouble. If there was no paper work it would be almost impossible to refute the claim. In the morning when reports come in on lost production and the amount charged against the electrical department seems excessive I can check the trouble-call tickets and if these tickets do not correspond with the down-time charged, I refuse to accept the responsibility and make a report accordingly.

To get breakdowns back into operation as soon as possible, it is sometimes advantageous to mount two motors so that the load can be shifted quickly from one to the other. When on car production and we were rolling a car off each line every forty seconds, even seconds were precious; so on our final conveyor drives we mounted two motors. The damaged motor would be changed at the first opportunity. If everything is in readiness, very few motors of reasonable size cannot be changed in a ½ hour lunch period.

Records are important and we keep them on all electrical equipment. In the case of a motor, the record card shows the equipment number, horsepower, speed, serial number, make, and frame number or size. We know where every motor is, when it was installed, when repaired, nature of repair, when greased — in short, a complete history since it came into the plant.

Instruments IN THE STEEL INDUSTRY

by K. M. FREEMARK

▲ AN instrument maintenance man has a very important job, inasmuch as poor information from inaccurate instruments is worse than no information at all. That can mean only one thing: your instruments must be correct.

A current of electricity is an intangible thing. If a gas or a liquid leaks from a pipe, there is usually some indication such as a sound, an odor or a puddle to call attention to the loss. But current may flow through a grounded circuit for years without its being detected, unless an instrument is on the lookout.

Electrical instruments are essentially delicate, their operating forces are small and their accuracy depends upon great refinement of construction, especially in such parts as pivots and jewel bearings. They should therefore be handled carefully, and not exposed to unnecessary vibration, moisture, or extremes of temperature. Portable instruments should be placed on a level support, and not too near each other, as they may affect each other's readings by 1 per cent or more if placed close together. If cover glasses must be wiped clean before taking readings, the observer should breathe on the glass to dispel any static charge which might be present.

Good contacts are essential to accurate measurements. This is essentially true in the use of millivoltmeters with separate shunts. There are four contacts in the connections between shunt and instrument, and as the resistance of the instrument is only a few ohms, a corroded or dirty terminal or binding-post surface may introduce errors of several per cent.

Since electrical instruments which are carried about and used at times under unfavorable conditions are liable to change, means should always be provided for their periodical testing. It is important to check switchboard instruments, not only when they are received from the maker but also regularly after they are mounted. This periodical checking should be done without dismounting the instruments from the positions in which they are used, in order that their errors under working conditions may be determined. The portable instruments used in such checking should be placed so as to be exposed as little as possible to stray fields. This condition may be shown to exist by turning portable instrument through 180 degrees and noting that the reading is not appreciably changed by the change of position. It has been shown that the removal and replacement of the pole pieces of a direct-current instrument — in fact, even the tightening of screws that hold the pole pieces — may affect the distribution of the magnetic flux so that a scale which fitted the instrument before the operation will now show appreciable errors. It is clear from this that any mechanical change, adjustment, or accident to an instrument should be followed by a test.

When an instrument fails to indicate, the possible mechanical defect may be:

1. Pointer sticking
2. Loose wires
3. Broken pivots
4. Element out of jewels
5. Pivots tight in jewels
6. Cross arms caught on adjacent parts
7. Coils warped
8. Damping vein sticking
9. Damping disk lying on magnet
10. Coils sticking due to foreign matter between coils
11. Misplaced coil cement

or the electrical defect may be:

1. Open coils
2. Shorted coils
3. Open resistance
4. Loose connections
5. Shorted transformer
6. Open in transformer winding
7. No external circuit
8. Opposite polarities in divided stationary coil

When an instrument indicates incorrectly, the mechanical defect may be:

1. Loose spring connections
2. Loose pointer
3. Loose pivots
4. Loose jewels
5. Friction or static
6. Sticking up scale
7. Off balance
8. Bent pointer
9. Pointer touching dial or glass cover
10. Pointer shaft touching coil
11. Spring convolutions touching
12. Spring touching adjacent parts
13. Annealed springs
14. Element shaft touching damping chamber cover
15. Damping disk touching magnet
16. Damping vein rubbing
17. Parallax
18. Zero shift
19. Spring set
20. Too much or not enough end play
21. Dial or element shift
22. Coils rubbing
23. Tail weight hitting zero adjusting pin

or the electrical defect may be:

1. Poor connections
2. Wrong connections
3. Grounds
4. Open shunt
5. Distorted coils
6. Partly shorted coils — series resistance or shunt
7. Reverse polarity
8. Temperature error
9. Magnetized metal cases
10. Frequency error
11. Field effects between elements
12. External field effects

Lubricants IN MAINTENANCE

by **V. A. SMITH**

▲ LUBRICATION is one of the principal means and perhaps the original step in promoting preventive maintenance. The service life of a given piece of equipment is almost directly proportional to the degree of lubrication it has received. However, *any* lubricant will not give the same degree of protection as will a carefully selected product. The selection of a correct lubricant is based on an analysis of the part to be lubricated, its operating characteristics, and the function the oil is to perform, such as absorption and radiation of heat, circulation and so on. It is not the purpose of this paper to discuss these fundamentals. Rather, we will assume that the product has been correctly selected and possesses all the necessary characteristics to produce the maximum in lubrication.

If a bearing or any other component part of a machine were correctly lubricated, its life would be almost infinite, barring, of course, accident. However, we know as time goes on that even a small amount of wear will eventually change the characteristics from those which originally prevailed, in which case we find it necessary either to replace or repair the part, or as has been done many times during the past several years, changing our lubrication recommendation to meet the new operating characteristics. As we know, this is an unsatisfactory approach to the problem, because no lubricant has been known to replace metal which has been removed by wear.

Let us assume, then, that we find it necessary to replace a bearing. One of the most important characteristics which must be considered in a recommendation is that of film-forming conditions. It is this factor which more than any other determines the performance of even the most ideally selected lubricant. The first consideration requires that the bearing be fitted with the proper clearance. On slow or medium speed bearings this is usually computed on the basis of one thousandth of an inch per inch of diameter of the shaft. On high speed bearings, that is, those operating in excess of 3600 rpm, this may be reduced to perhaps one-half a thousandth per inch of diameter, and in extremely high speed bearings, those operating above 5,000 rpm, we are today lubricating spindles which have what is known as "zero clearances." The important influence of clearance is its effect on viscosity of the lubricant, since an oil which would be recommended normally for a given application might be too light and be squeezed out if excessive clearances were allowed in setting up the new bearing. On this same basis it might be entirely possible that the use of too heavy an oil for a relatively smaller clearance would result in excessive fluid friction, overheating, and ultimate bearing failure.

Another factor which is often overlooked in the rebabbiting or rebuilding of bearings is the effect of improper grooving. Many of the older school in the mechanical departments still adhere to the idea of using the bearing as an outlet for their artistic talents. Most grooves that are incorporated in a bearing, with perhaps the exception of those used to introduce grease to slow or moderate speed bearings, have negative rather than positive values. They reduce the bearing area, raise the projected pressure per square inch and even permit the oil to escape rather than confine it in the pressure area. For most two-piece bearings a suitable chamfer at the

point where the parts join, extending to within a quarter or half inch of the end of the shell, depending on its size, is all that is required. This forms a reservoir in an area of relatively low pressure and permits the oil to be pulled into the pressure area to support and actually lift the shaft in fully flooded bearings. Where a condition of boundary lubrication exists, that is, where bearings are lubricated by hand can, drop feed oiler, or similar all-waste methods of application, the chamfer sometimes serves as an additional reservoir for the oil. Attention should be called, however, to the fact that in certain grease applications a distributing groove has been found necessary, but this should also be located on the leading side of the bearing ahead of the pressure area.

Many applications have been developed for anti-friction bearings during the past several years. The electric motor is an excellent example. One of the most common sources of trouble in the lubrication of anti-friction bearings has been the over-zealousness of the oiler in making certain that the bearing is filled. As a result he keeps it packed at all times, causing it to run hot and resulting in failure. If the grease is being applied with a pressure gun the seals may be broken and grease actually fed into the windings. Where a bearing is hand packed and an excessive amount of grease is used, this condition may also result, since the grease would have a tendency to expand as it is heated and might also blow out the seals. Grease or oil finding its way into the rubber insulation may cause its deterioration and the loss of the motor.

While you may have the properly selected lubricant, and while your equipment may be designed to use it in the most correct and economical way, you still have the human element to contend with. During the present emergency, there has been a tendency in many plants, not only in steel mills, to minimize the importance of the oiler in the overall production scheme. In fact, in many plants it is considered among the lowest if not the lowest rating of job classification in the entire plant scale. This is a very serious mistake, since the oiler has as his responsibility control over equipment the cost of which may run into five and sometimes six figures. If he is at all lax in his duties, serious troubles may result. Too much stress cannot be laid on the fact that the employment and supervision of well trained oiler men will pay dividends.

In a well organized lubrication program means should be devised to simplify the oiler's work as much as possible. This may even consist of spotting points to be lubricated with various colors and tying this color scheme in with the lubrication dispensers and even the storage equipment in the oil house. Many plants have used a system in which an oiler carries a distinctive punch and each machine is suitably tagged. When he completes his work on the machine, he punches the tag and moves on to the next piece of equipment to be lubricated. Any other man following him on the next turn knows exactly what work he has done and can pick up where he left off. While it may be thought that the employment of suitably trained oilers is an unnecessary expense, it is a very definite contribution in terms of preventive maintenance, since it takes from the machine operator the responsibility of lubricating his own equipment, a duty which under stress of production he often overlooks or deliberately neglects.

In the interests of good housekeeping, a suitable oil and grease storage should be set up in the plant. This should be in a clean, dry, heated and well lighted location, centrally situated in the plant if at all possible. All oils and greases should be kept in closed containers to eliminate the possibility of contamination with dirt, dust or other foreign materials. It is good practice to keep all oil stores under the responsibility of one individual and insist that the oil house be locked at all times. This has eliminated any possibilities of sabotage which at one time seemed a very serious menace. The oil stores keeper should also be responsible for the reclamation of any oils or greases which may require treatment. He should be instructed in the proper use of centrifuges if this type of equipment is employed, and also in the proper handling and repacking of activated clay or cotton or waste-packed filters if they are used. In the reclamation of any lubricant the supplier's instructions should be followed as to temperature employed, rate of cooling, etc. The lubricating characteristics of oils or greases may be damaged or entirely destroyed by improper handling. When and if batch purification can be utilized, it is to be preferred to by-pass filters, since a more thorough job of reclamation can be done.

All of this can be successfully controlled if a lubrication supervisor is appointed in the mill or plant. While in terms of dollars spent the total lubrication cost on a per pound or per gallon basis may be comparatively small in comparison with expenditures for other production materials, the influence it exerts is much more far reaching. The power consumed, the production lost because of time out and the actual cost of maintenance in terms of parts replaced far offset any amount which might be spent for lubrication when figured as a direct cost item. The lubrication supervisor, therefore, is in a position to save many times the cost of the operation of his department. He should be a man with a good mechanical background, one who is actively interested in securing all the information and assistance he can from his suppliers, and who is familiar with new developments in the field of lubrication. All matters pertaining to lubrication should clear through him and any requests for recommendations for lubricants originating in the plant should be cleared through him. There have been very few instances in our knowledge where the savings accruing from the services of a well qualified lubrication supervisor have not paid real dividends.

As mentioned in the opening of this paper, lubrication is preventive maintenance. It is one item in a preventive maintenance program which is usually omitted or discounted. However, if a bearing or gear is lubricated correctly, its life expectancy is prolonged. Should failure occur for any reason and replacement becomes necessary, the application of the above fundamentals of correct grooving or lubricant use should lengthen the life of the replacement part. Correct lubrication is preventive maintenance plus power savings and greater availability of equipment for production.

MAINTENANCE OF *Flow Meters*

by R. C. ASCHER

▲ METERS for measuring gases and fluids can be divided into three classes: displacement meters, velocity meters and differential meters. I shall limit this discussion to the differential type of meter and will refer to them hereafter as flow meters.

All flow meters work on the principle of taking the difference in pressure across a restriction in a pipe and impressing this differential pressure on a metering device. The restriction in the pipe is usually referred to as the "primary device," and the meter is referred to as the "secondary device."

A few primary devices in common use are the following: thin plate orifice of the concentric type, thin plate orifice of the eccentric type, thin plate orifice of the segmental type, flow nozzle, venturi tube and pitot tubes.

All differential pressures created by these primary devices vary as the square of the flow.

Secondary devices may be divided into mechanical or electrical types, and each of these types may be further divided into meters that register differentials only, or meters that extract the square root of differential and register on evenly divided indicating dials or charts. Mechanical meters are usually of the float or torque type. Evenly graduated dials or charts on these meters are obtained by special shaped floats or cams to extract the square root of the differential. Integration on these meters is usually actuated by an electric clock on a basis of four times per minute. The accuracy of this integration is dependent upon constant frequency current supply to the electric clock and to the mechanical precision of the integrating mechanism.

Mechanical meters are limited to location in that the secondary device should not be over 100 ft from the primary device, and in the case of steam or fluid measurement should be located below the primary device.

Electric meters employ various means of transmitting differentials to distant points, the most common being selsyn motors, inductance bridge and resistance of the electrical circuit. Many of these meters are a combination of a mechanical meter with electric transmission and a mechanical integrator in the receiving instrument.

In industry today it is not a question of do we need meters, but how far shall we go into the problem of metering? The steel industry has found out that flow meters are required on all steam generating units, turbines and departmental processes, including heating. Also, that all air, gas, oil and water should be metered to the large process users. Metering of all these utilities helps prevent waste, and also furnishes a means of properly charging the various processes with its share of these utilities. In addition to this, indicating and recording meters are a great help in serving as a guide to the correct operation of these various processes.

This brings up the problem of maintenance and checking meters for accuracy. Each meter manufacturer endeavors to supply complete instructions covering the proper methods of installation and care of meters. The members of the various meter companies have served on the A. S. M. E. Fluid Meter Committee from time to time with the purpose of standardizing on the procedure for calculations of primary devices, and to establish standards on the proper materials for the various primary devices.

For installation and maintenance of meters in a large industrial plant I will borrow the procedure used for years in a plant having at least three hundred meters of various manufacture. Before ordering a meter, care should be taken that the primary device is located properly, and by working with the engineering department during the planning stage, sufficient straight pipe lengths should be allowed for the primary device.

As soon as a meter arrives in the plant all parts should be checked to see that the manufacturer or the plant receiving department has not mixed up the shipment. Meter manufacturers all supply a data and record sheet giving details such as orifice size, serial numbers, pressure, temperature and flow, together with type of secondary device, etc.

The installation of a meter is important, and the following points should be carefully checked:

1. Internal diameter of pipe.
2. Internal diameter of orifice plate.
3. Tap spacing (taps must be level and flush with inside of pipe).
4. Proper grading of piping.
5. Proper location of secondary device or transmitter.
6. Follow manufacturer's instruction in filling meter body, being careful to keep dirt or foreign matter out of meter body as well as to eliminate any entrapped air.
7. Blow out connecting piping and allow lines to fill with condensate if steam is being metered.
8. Check connecting piping for leaks.
9. Put meter in service.

A written record should be kept on the service rendered each meter, such as periodic blowing out of lines, checking, resetting meter body for zero, and calibrations made to any of the instruments. The frequency of this check will depend upon the service to which the meter is subjected, but as an average we might suggest every ninety days.

Meters, transmitters and instruments should be checked for calibration at least once a year, and a record of corrections noted on the meter record sheet. This check should be a hydrostatic test of the meter proper at several points, such as 20, 40, 60, and 80 per cent of meter range.

There are two methods used by meter men in caring for meters. One method is to not touch the meter until it goes out of order, and the other to maintain it by periodic inspections. Of these two methods, the latter is the most successful.

DISCUSSION

PRESENTED BY

W. E. REIBER, Assistant Chief Electrician, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

JOHN STEWART, Chief Electrician, Plymouth Motor Company, Detroit, Michigan

C. F. COWLEY, Lubrication Engineer, Fiske Brothers Refining Company, Lubriplate Division, Toledo, Ohio

E. R. BRANDAU, Industrial Lubrication Service Engineer, Gulf Refining Company, Detroit, Michigan

V. A. SMITH, Industrial Sales Manager, Socony-Vacuum Oil Company, Inc., Detroit, Michigan

L. S. VOIGT, Master Mechanic, Coke Division, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

R. C. ASCHER, Republic Flow Meters Company, Detroit, Michigan

H. E. PHELPS, Superintendent Electric Furnace Department, Rotary Electric Steel Company, Detroit, Michigan

W. D. FREY, Application Engineer, Westinghouse Electric Corporation, Detroit, Michigan

C. E. S. EDDIE, Assistant Superintendent Power and Fuel, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

A. C. PASINI, Technical Engineer, Detroit Edison Company, Detroit, Michigan

J. L. BUELL, JR., The Reliance Electric and Engineering Company, Detroit, Michigan

M. L. COVER, Superintendent Sintering Plant, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

W. E. Reiber: Mr. Stewart mentioned finding miscellaneous material in the control boxes — quite a few belongings of the operators. I do not believe that point can be stressed too much, not only from the standpoint of breakdown of equipment, but from the standpoint of the man's safety while putting the material in and taking it out. It seems to be an habitual thing, and I wonder if Mr. Stewart could enlighten us on what they might be doing at his plant to keep this hazard down.

John Stewart: There is one thing that can be done and that is to use some kind of a screw or fastener to keep the panel closed, something you have to use a screwdriver or wrench on. Probably some machine operators will have a screwdriver, but if it is a question of taking a screw out of the panel, they will not do it.

C. F. Cowley: I agree very strongly with Mr. Smith on the point he brought out on the question of the handling of lubricants. Those of us in the production of better lubricants are striving hard to improve them. This is of no avail if the covers on grease drums are left open or the lubricants are handled by rough methods, allowing dirt to be mixed with the lubricants prior to their use. This point cannot be stressed too strongly.

One point I would like to add is the effort that is being made in the reduction of the number of grades of lubricants used. I am especially thinking of the greases for it is there we can do a lot toward reducing the number of grades necessary to lubricate the various equipment. The reduction of the number of grades would help in a lot of plants because usually the type of men they have handling lubricants will make mistakes if there are too many grades causing complications.

Another point Mr. Smith brought out is very close to all lubrication engineers and that is the hope that a better type of man with a higher intellect could be used for the handling of lubricants in our industrial plants. This would be a great advantage.

E. R. Brandau: Mr. Shimmin mentioned cooperation. I think all the major oil companies have some sort of service plan which is cooperative. I would like to hear a little more from Mr. Smith on what the oil companies offer in the way of cooperating with the people who are directly concerned with maintenance, and possibly hear from some maintenance men as to how the representative from an oil company can best cooperate with them.

V. A. Smith: The oil industry as a whole has been convinced more and more as time has gone on that we are not selling a commodity; we are very much in a service activity.

The old idea of lubrication in the steel plant was primarily the use of a certain salient oil — what we know as a black oil and a red engine oil took care of everything. With the improvements in modern rolling equipment, greater pressures have put real loads on the machinery. We have developed extreme pressure lubricants that have done more than we ever hoped they would do. For example, a certain oil will now take a pressure of 12,000 psi. Extreme pressure loads go up to 70,000 psi, so the oil industry as a whole is more in the mechanical industry today than ever, but this cooperation we try to offer is based, first of all, on research and development.

Development of products for specific jobs go back to the builder of equipment. We work with him before the equipment leaves the drawing board, and all through the various phases. We have trained field engineers whose job is to go into the plant and work with the operating and maintenance personnel. If they have trouble we try to shoot that trouble, try to liquidate it as it develops. If it is a question of product, we try to improve the product.

I mention in passing the idea of training the oil man and building him up to the point where he is a real factor in building up the plant and in preventive methods. We have in some instances gone into plants and charted the different points of application. In other words, on an electrical motor we may use a red dot, and for another purpose, we may use a green dot. You can go through all the colors of the rainbow. Then we have the oil cans painted that particular color, and even the drums. The type of man who usually starts in as an oiler may be of almost any scale of intellect. He may have had a lot of experience and he may have had very little experience. So in order to meet this condition and to make the work as fool proof as possible, we have developed these schemes of color charting equipment We have also developed distinctive tags indicating by color and

by name the products to be used and the various points of application.

But even with all this, it again is a cooperative effort in that the supplier should be given access to the plant to learn the problems and try to offer a solution. There is a very definite training in back of every man who is selling lubricants today that should be taken advantage of.

L. S. Voigt: I was very much interested in Mr. Shimmin's preliminary address. His plan of prepared maintenance seems very good to me. When I started in this game I did not know much about planned maintenance and did not hear anything of it from others. It seems to be more or less a development of recent years. I have been practicing this plan for some years, and I think it is the only thing.

I was interested in Mr. Stewart's discussion of records. I would like to see the maintenance department get a cost sheet for each month, showing what was spent and why, and how it relates to the operating costs. Some plants do that, but some do not.

I was also interested in Mr. Smith's description of wearing a bearing partly out and then flooding it with grease. It is like eating a good meal at Christmas time and hoping that it will do you for the rest of the year. It just does not work out.

I would like to ask Mr. Ascher what effect it has on a flow meter if you place an orifice in a pipeline that is horizontal, and the pipe then fills up with water or other material to the level of the orifice. How do you correct that?

R. C. Ascher: In the case of steam measurement where moisture is present, there are definite standards set forth by the A. S. M. E. Fluids Committee. A small drain hole should be provided in the bottom of the orifice plate, so that the moisture will not collect upstream of the orifice but will drain to some low point in the line where it can be trapped out of the system.

If a drain hole is not provided and moisture collects in front of the orifice plate, you have the same effect as changing the size of the pipe in which the orifice is located, and this does affect the accuracy of the meter because the ratio between the inside pipe diameter and the orifice diameter has been changed.

An interesting case of changing orifice diameters was found some time ago at the Zug Island Plant of the Great Lakes Steel Corporation. Mixed coke oven and blast furnace gas was being measured by an orifice in a 42 in. line. The low differential gas meter connected across the orifice had a tendency to increase in flow over a period of six weeks and would not check with meters measuring coke oven gas and blast furnace gas, the discrepancy going as high as 3 per cent between these meters. Then, suddenly the meter would correct itself, and it was noticed that a sudden dip occurred in the mixed gas recorder chart. It was finally decided that tar or wax deposit was building up on the orifice edge (⅛ in. wide). An opening was made in the gas line to enable them to clean off the edge of the orifice periodically to correct this cause of meter error.

H. E. Phelps: I might make a little comment on Mr. Voigt's suggestion of maintenance costs. In our plant the operating superintendent receives the daily cost in his department, which is very much in line with what was mentioned. Sometimes it causes a slight difference of opinion between the operating superintendent and the maintenance superintendent.

W. D. Frey: Carbon brushes are an important item in maintenance, and while they were not mentioned in these papers, I might briefly mention some experiences with brushes on planes.

Earlier, when the bombing planes would get above 30,000 ft, the carbon brushes on the d-c generators and motors would burn out or wear down in about 3 hours flying time. This, of course, would affect the operation of bomb bay doors, landing gear, etc. So the problem was immediately turned over to research engineers, who discovered special treatment for this purpose. Now the life of the brushes has been increased to somewhere in the neighborhood of 600 hours or approximately the interval between overhauls.

With this treatment, we can now make a brush which will also give considerably increased life on machines used on the ground as well, and we expect a decided improvement in brush operation on machines so equipped after the war.

C. E. S. Eddie: It might be well if Mr. Ascher would say something about the necessary corrections on flow meters.

R. C. Ascher: The accuracy of a flow meter is plus or minus two per cent over a flow range of 25 per cent of maximum flow to maximum flow. That is the accepted guarantee of the A. S. M. E. Fluids Committee and meters are generally sold on that basis.

Then, once in a while, someone runs weighed water tests on our meters, and they find out that at 10 per cent of flow range a meter may be as much as 15 per cent off, which causes us some embarrassment.

In cases where extreme accuracy is required over a wide range of flow, we recommend the public utilities' practice of having differential devices calibrated, and necessary corrections made to secondary and meter registering devices. This may cost as much as $500 extra per meter, and naturally cannot be included in a standard meter.

One thing should be kept in mind about flow meters. The differential varies with the square of the flow, so if you design a meter to register 100 in. of water differential at maximum flow, when you get down to 10 per cent of flow you only have one hundredth of that differential, or one inch of water.

As mercury is usually used in meters, and that in itself is 13.6 times heavier than water, at 10 per cent of flow you are dealing with a head of one-thirteenth of an inch. Any slight variation in that will throw your meter accuracy off considerably. Thus it can be seen that wide range metering is not an easy problem.

A. C. Pasini: I might add something to Mr. Stewart's discussion. We have learned that it is advisable to leave the drain plug out of high speed rotary ballbearing housings for a period of time to get rid of the excess grease. We have found out that replacing the plug immediately after repacking a bearing with grease results in damage because of over-pressure created by the grease. By leaving the plug out, excess grease runs out and allows complete spreading throughout the ball bearing and housing. A one-hour run should be suffi-

(*Please turn to page 91*)

A. I. S. E. STANDARD DESIGN

FOR *Crane Shaft Couplings*

Committee:
Chairman, F. W. Cramer, Carnegie-Illinois Steel Corporation
E. L. Anderson, Bethlehem Steel Company
F. E. Kling, Carnegie-Illinois Steel Corporation
R. N. Thompson, Great Lakes Steel Corporation
H. W. Ball, Morgan Engineering Company
J. T. Bradford, Jones and Laughlin Steel Corporation
James Farrington, Wheeling Steel Corporation
H. W. Neblett, Inland Steel Company
Wm. Mursch, Carnegie-Illinois Steel Corporation
W. C. Heinle, Cleveland Crane and Engineering Company
E. W. Rice, Whiting Crane Corporation
I. N. Tull, Republic Steel Corporation
C. H. Schramm, Shaw Box Crane Company
W. L. Poto, Alliance Machine Company
E. H. Windolph, Alliance Machine Company
R. J. Wadd, Harnischfeger Corporation

The sub-committee on couplings has completed its work on proposed standards for couplings to be used on shafting as a part of the A. I. S. E. Specifications for Heavy Duty Mill Type Crane.

The committee's investigation of this subject indicated a wide variety of shapes and sizes now in use, the result of many years of designing with no overall specifications to use as a guide. Each of the major crane manufacturers, in addition to many of the steel companies, has coupling standards in use. Many of these standards were submitted to the committee for review and comparison, so that the recommendations adopted represent compromises from many designs.

One of the major decisions to make was the number of sizes of couplings needed to cover the range of shaft sizes (2½-6 in. inclusive) normally used on cranes. The decision was made to have four sizes as follows:

(a) For shafting 2½-3 in. diameter.
(b) For shafting 3⅛-4 in. diameter.
(c) For shafting 4¼-5 in. diameter.
(d) For shafting 5¼-6 in. diameter.

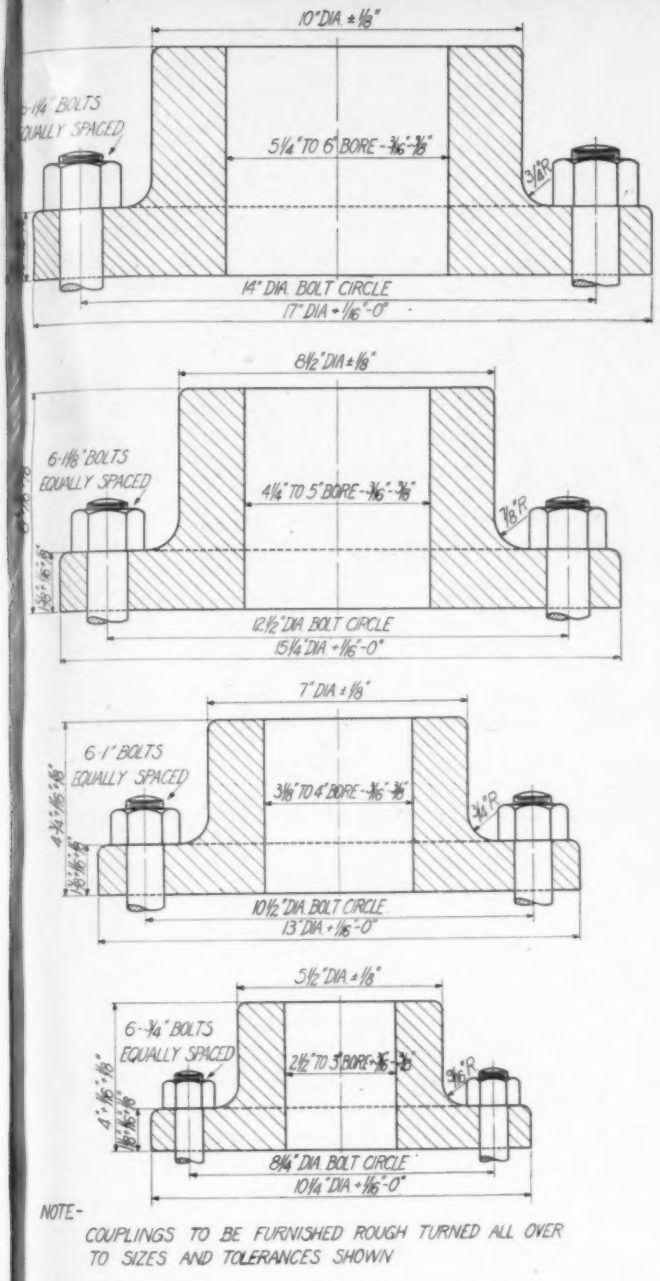
It was also decided to use 6 bolts in all four sizes. The shearing stresses on the bolts specified will vary from 2310 to 4000 psi in (a); 2050 to 4250 psi in (b); 2720 to 4450 psi in (c); and 3850 to 5750 psi in (d). These stresses are lower than the maximums found in many of the existing couplings and well under the allowable maximum for this type of service.

There are two methods quite commonly used to carry the load through the couplings:

(1) By the use of body-bound bolts.
(2) By the use of face keys between the two halves of the coupling, plus plain bolts.

The proposed couplings are so designed that face keys can be used if this method is preferred. Standard keys of ⅝ in. x 1¼ in., ¾ in. x 1½ in., ⅞ in. x 2 in. and 1 in. x 2¼ in. are recommended for the different sizes. When using this scheme, it is preferred that two short keys, each extending to within 1/16 in. of the bore, be used in place of a single key. This eliminates any machine slot work in the ends of the shafts. The center line of the keys coincides with the center line of opposite bolt holes.

All couplings are designed so that special wrenches are not required for the nuts. They are to be furnished by


10"DIA ±1/8"
6-1¼" BOLTS EQUALLY SPACED
5¼" TO 6" BORE - 3/16" - 3/8"
3¼"R
14" DIA. BOLT CIRCLE
17" DIA ± 1/16" - 0"
8½"DIA ±1/8"
6-1⅛" BOLTS EQUALLY SPACED
4¼" TO 5" BORE - 3/16" - 3/8"
7/8"R
12½" DIA BOLT CIRCLE
15¼" DIA ± 1/16" - 0"
7" DIA ± 1/8"
6-1" BOLTS EQUALLY SPACED
3⅛" TO 4" BORE - 3/16" - 3/8"
¾"R
10½" DIA BOLT CIRCLE
13" DIA ± 1/16" - 0"
5½" DIA ± 1/8"
6-¾" BOLTS EQUALLY SPACED
2½" TO 3" BORE - 3/16" - 3/8"
9/16"R
8¼" DIA BOLT CIRCLE
10¼" DIA ± 1/16" - 0"
NOTE-
COUPLINGS TO BE FURNISHED ROUGH TURNED ALL OVER TO SIZES AND TOLERANCES SHOWN

the manufacturers rough turned all over to within the tolerances shown.

The so called "safety coupling" which has the bolt heads and nuts in a recess protected by a wide rim were not adopted as a standard. It is the usual practice to include a cover when this type is installed for further protection, as some danger exists from the rotating ends of the bolts. The required use of special socket wrenches for this type of coupling has not met with favor.

The accompanying sketch shows the principal dimensions and tolerances for the four standard couplings as recommended by the committee. While it is realized that it will require several years of replacements to apply these couplings to existing cranes, it is hoped they will be used on the new ones.

It is proposed to adopt these couplings as a tentative standard for one year, after which any comments received will be reviewed and necessary changes made.

MAINTENANCE DISCUSSION

(*Continued from page 89*)

cient to get rid of the excess grease, then the plug can be reinstalled.

J. L. Buell, Jr.: The lubrication of ball bearing motors has been mentioned several times and I believe that it is the biggest item of maintenance on a modern squirrel-cage motor. The means of lubrication seems to be the largest part of the problem. How to add grease, and when, and how much, are the questions confronting the motor maintenance man. Over-lubrication rather than under-lubrication causes the most failures.

Several large automobile plants have found it advantageous to eliminate all greasing of motors in the field. They actually lose fewer motors under that plan than when they arrange for periodic lubrication by a man in the plant.

This is something that an automobile plant can probably do more successfully than a steel plant, as they have many plant changes and it is not often that more than two or three years go by without a machine being moved. When a machine is moved its motor is brought into the electric shop and dismantled, and the bearings flushed out and repacked with fresh grease.

With present construction it is difficult for an oiler to know how much grease to add to a bearing, but the motor manufacturers are giving a lot of thought to the matter and after the war you will be able to get motors that have greatly improved means of lubrication and hence will be much easier to maintain.

M. L. Cover: Regarding the trouble in metering the surplus gas mentioned by Mr. Ascher, we found that the meter seemed to read accurately at times and then quite suddenly seemed to be quite erratic. When I investigated the cause of this, I found two things that probably balanced each other at times and gave the apparently correct readings noted at times. First, I found that the small hole in the bottom of the orifice, which Mr. Ascher explained was for drainage, never really did what it was supposed to do. The pipe line was sloped in the direction of gas flow toward the orifice and a large quantity of water had collected up stream from the orifice. This caused the meter to read low. A drain connection was installed. When the water was draining out, the meter reading gradually increased.

Second, flakes of naphthalene gathered on the orifice and made the orifice smaller. This increased the indicated flow of the gas. Washing with light oil eliminated this condition.

Almost all makes of electric meters are quite accurate. Their job is simple. They merely measure and record a pressure differential. However, there are many things that affect the pressure differential and cause the meter to tell a fictitious story. I have made a total meter balance against 5 other meters to within ½ per cent. I have also made a coke oven gas meter and a blast furnace gas meter balance up with a mixed gas meter and had the sum of the Btu in the two gases add up to the mixed gas Btu to within a fraction of 1 per cent.

STEEL PLANT *Welding*

. . . . setting forth some examples of welded construction in steel plant equipment which demonstrate many possibilities of economy . . . .

by W. K. Simon, GENERAL FOREMAN
WELDING DEPARTMENT
CARNEGIE-ILLINOIS STEEL CORPORATION
CHICAGO, ILLINOIS

▲ BEFORE discussing details, it may be well to review the origin and development of the welding department at the South Works of Carnegie-Illinois Steel Corporation. This department was established during World War I, when welding first came into use as a means of making emergency repairs. Lack of technical knowledge and practical experience, inferior welding materials and equipment, combined with the difficulties then encountered in recruiting and training operators, all tended to cause a lack of confidence in welding. In spite of these handicaps, however, many believed in its possibilities, and its application has progressed steadily because of the unceasing efforts of those who pioneered its use.

Improvements in welding equipment and materials, savings in time, cost and effort have aided greatly in extending its use. One outstanding advance was the introduction of shielded arc welding some fifteen years ago. With its introduction, welded fabrications that formerly were dreams are today almost routine, for welding has now taken its place among the established trades. Certainly the service it has rendered made possible the vast production of armament and munitions necessary to win the present war.

Welding processes utilized in the department are manual arc (both a-c and d-c), automatic arc, spot, oxy-acetylene and thermit. Related processes include brazing, lead burning, oxyacetylene burning, shape cutting, flame hardening, hard facing, low temperature brazing, oxygen lancing, layout and assembly work, etc.

The shop differs from most in that all weldments are layed out, cut to shape, assembled and welded to blue print specifications within the confines of the department. The transition from raw materials to finished

Figure 1 — The largest and heaviest of all welded fabrications built to date at South Works, this beam mill Manipulator weighs 90,000 lb, and has an overall length of 31 ft, 8 in.

Presented before A. I. S. E. Chicago District Section Meeting, April 3, 1945.

Figure 2 — Manipulator side-guard for 44 in. slab mill. The fabrication consisted of 277 flame-cut pieces with an approximate weight of 67,500 lb.

weldment, with the exception of heavy bending, forming or rolling that may be required, is strictly the function of the welding shop.

A good portion of the maintenance work is performed in the field, which makes possible continued operation of the various mills by eliminating the lengthy and costly dismantling operations required to replace worn or broken equipment.

Repair jobs are a sizable portion of both shop and field work. Where feasible, the equipment is dismantled, the defective part removed and sent to the shop for reclaiming. Time, however, is an important factor in a steel mill and therefore repairs, especially of the emergency type, are an everyday occurrence in the field.

Fabrication is confined to the shop and at present amounts to about 50 per cent of the shop activities. This phase of operations is one that is increasing by leaps and bounds, with no sign of an ultimate goal. The illustrations which accompany this paper will demonstrate this point better than words can possibly explain.

One of the more recent phases of welding, the hard-facing process, is playing a prominent part in work done by the welding department, with indications that it is still in its infancy so far as applications are concerned. At present we are hard facing spindles and coupling boxes, pug mill paddles, shear knives, soaking pit tong bits, reheating furnace skid pipes, scrap chutes, guides, side plates, gag press anvils, conveyor buckets, mud gun pistons, bleeder valves, bucket tray lips, and numerous other items.

Automatic arc welding at present is limited strictly to build-up work that can be rotated in a lathe with a 21 in. swing and a 24 ft bed. This work consists of shafts, journals, crankshafts, truck wheels, or any circular object that needs building up. The advantages of automatic arc welding are becoming much more apparent and undoubtedly will increase in importance and usage in future work.

Spot welding is a process that has a comparatively small place in a steel mill, for the work is seldom light enough to permit using it effectively. In the South

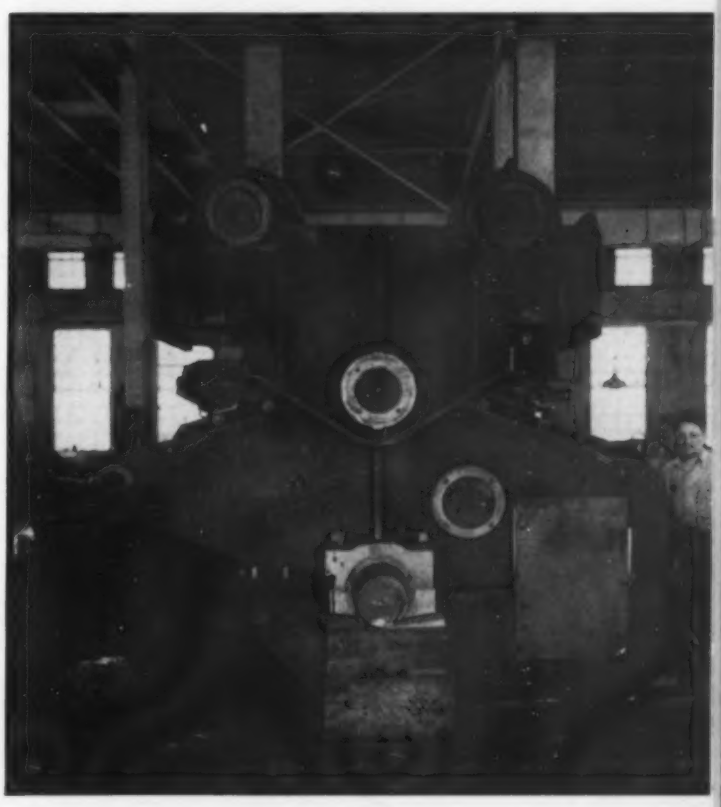
Figure 3 — Another type of side guard for 44 in. slab mill, with a total weight of 43,500 lb.

▲

Figure 4 — Showing a number of table frames. This job was completed in 21 days. Total weight of the assembly, 25,800 lb.

Figure 5 — This gear housing for 54 in. beam mill illustrates what can be done by welding on jobs of a more finished nature. Dimensional measurements were held to within ¼ in. of the finished surfaces.

↓



Figures 6 aud 7 — Above is shown the raw material in the form of a pile of slabs, and below is a bearing stand 51 hours later, ready for stress relieving and machining. Although time was the important factor in this case, a considerable saving was realized in comparison with a casting.

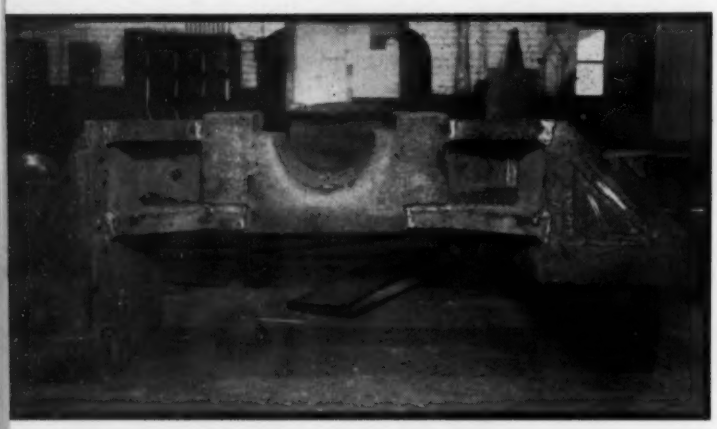
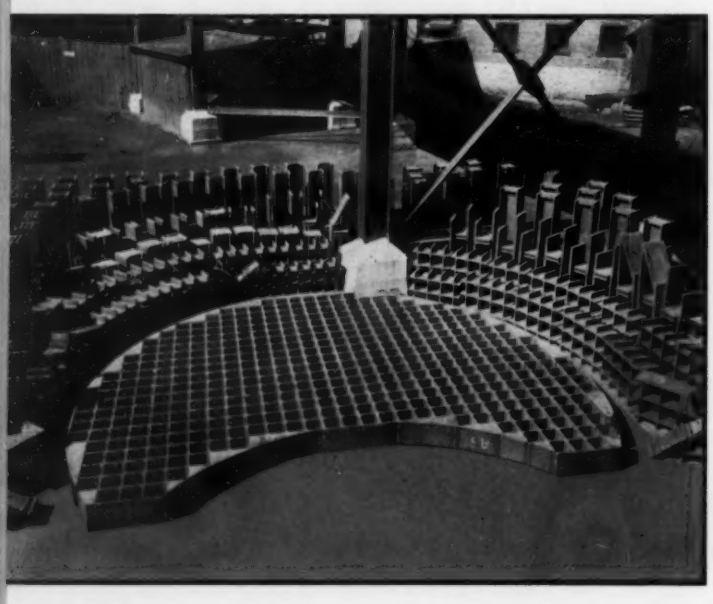


Figure 8 — Checker support grids, columns and girders for blast furnace stove. In this case, all plates were oxyacetylene stack-cut in multiples of five. The plates were one inch thick and were cut, assembled, and welded within tolerances of $\frac{1}{64}$ in. over and nothing under.



Works tin shop, however, rivets and soldering are the exception rather than the rule since the first spot welder was installed.

Oxyacetylene welding still represents a substantial part of the work in both the shop and field. Although it has been replaced in some cases by the arc, the indications are that it will always have its place wherever and whenever it is suitable.

Practically all the high and low pressure piping throughout the mill is oxyacetylene welded. All alloy chains and a large proportion of carbon steel chains still in use are oxyacetylene welded. This operation is confined to the shop and all welds are stamped with the welder's identification number. Fortunately, we have seldom had to account for a failure in the welded link.

Additional oxyacetylene applications consist of "safe-ending" boiler tubes, cast iron welding and brazing, hard facing, lead burning, building up switch points, pointing tong bits, aluminum welding, copper welding and others too numerous to mention.

Thermit welding is the oldest process of fusion welding, yet the average welder knows comparatively little about it. In a steel mill where most of the equipment is of a heavy nature, thermit welding has an essential use in joining sections that could not be welded by any other means.

Thermit, as employed for welding, is a mechanical mixture of finely divided aluminum and iron oxide in the form of magnetic iron scale. Upon ignition at about 2800 F, a reaction takes place lasting about 30 seconds and elevating the temperature of the mass to approximately 5000 F. This is a chemical reaction resulting from the high affinity of aluminum for oxygen. After the reaction the mass separates into pure iron and aluminum oxide. The aluminum oxide floats to the top of the mass, leaving the iron, which is heavier, in the bottom of the crucible ready for tapping.

In making the actual weld the first step is to line up the parts and cut a parallel gap at the point where the weld is to be made, the width of the gap depending upon the size of the section. Around this gap a wax pattern is formed and a refractory sand mold built. The parts to be welded are then preheated by means of natural gas or kerosene burners introduced into the mold through openings provided for that purpose. Preheating, which continues until the parts become red hot, burns out the wax of the pattern and dries out the mold.

Reaction is started by means of a small quantity of ignition powder placed on top of the thermit. The specially designed crucible is tapped after the reaction, allowing the thermit metal to run into the mold. The thermit metal gives up its superheat to the parts being welded, fuses with them and upon cooling a fusion weld is formed. During the past two years the welding department at South Works has thermit welded 120 jobs consisting of 22 open hearth charging rams or peels, 10 manipulator rams, 15 spindles, 10 work and back-up rolls, 8 pinions, 5 ladle car frames, 15 stripper tongs, 4 gas engine piston rods, 6 rail jobs, and 25 miscellaneous items, including shafts, racks, trunnions, roll housings, side guard, etc.

In conclusion, it should be said that South Works owes a debt of gratitude to other Carnegie-Illinois plants and to the manufacturers and distributors of welding products for assistance and information regarding all

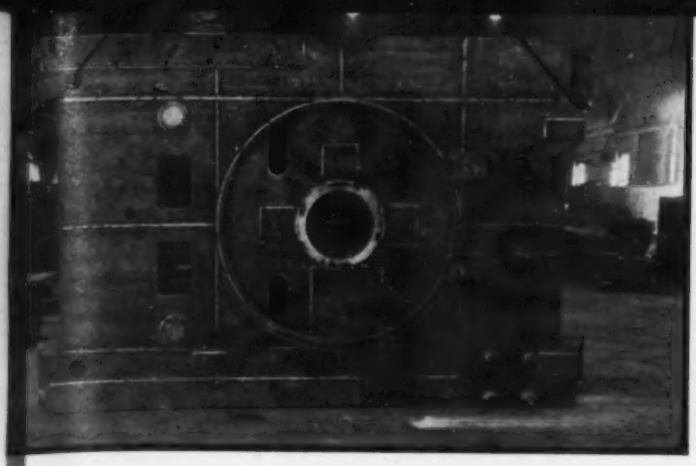
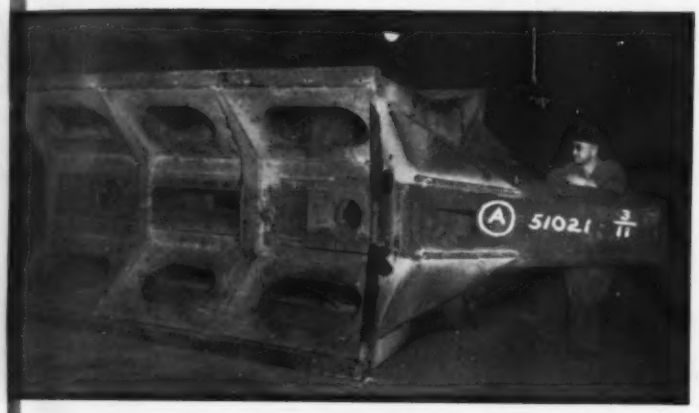


Figure 9 — Trolley frame for open hearth stripper crane. Bending and rolling were performed by the boiler shop. All other work, including assembly, was completed in the welding shop. This fabrication has held up where two castings failed before.

▲

Figure 10 — Upper ram section for 25-ton soaking pit crane. In this weldment there is a combination of rolled plate, bars, beams, and a casting.



types of welding. Without the combined efforts of all concerned it would not be possible to achieve our ultimate goal.

DISCUSSION

PRESENTED BY

R. W. SHEFFLER, Sheet and Tin Mill Division, Carnegie-Illinois Steel Corporation, Gary, Indiana

W. K. SIMON, General Foreman, Welding Department, Carnegie-Illinois Steel Corporation, Chicago, Illinois

A. B. GLOVER, Assistant Electrical Engineer, Acme Steel Company, Chicago, Illinois

A. PREUSS, General Foreman, Tubular Alloy Works Division, National Tube Company, Gary, Indiana

K. A. DAUGHERTY, Electrical Engineer, Tubular Alloy Works Division, National Tube Company, Gary, Indiana

R. W. Sheffler: I would like to ask if thermit welds are annealed after they are made.

W. K. Simon: As a general rule we do not anneal the thermit weld after it has been made. The reason is that the size and shape of the job being welded make it difficult or impractical.

So far as the advisability of annealing, the same thing would hold true in the case of a thermit weld as in a casting. Due to the fact that the thermit weld proper is superior to the parent metal in most cases, the annealing operation if used would be more necessary so far as the parent metal is concerned, than the thermit weld itself.

A. B. Glover: Will you expand on oxygen lancing as mentioned in your paper?

W. K. Simon: Oxygen lancing as used in our plant has various applications, although the basic principal used remains the same. The oxygen lance consists of a holder known as a lance head, which in turn is connected to a half-inch oxygen hose through which oxygen is supplied by an oxygen regulator of sufficient capacity to supply the necessary amount of oxygen to make the cut. A length of standard quarter-inch steel pipe is screwed into the lance head.

In making the actual cut, the metal to be lanced is preheated by means of an oxyacetylene heating torch to a temperature where the metal becomes molten and at a point where the cut will start. As soon as the preheat has taken effect the lance is brought into use and the oxygen alone is used to continue the cut. As the cut progresses the pipe will be consumed, and depending on the size of the job, may have to be replaced.

The applications consist of cutting heavy sections of cast iron or steel beyond the range of conventional cutting torches, removing the plug in the tapping hole in the blast furnaces, electric furnaces and open hearth furnaces, punching holes through heavy steel sections and other similar operations.

Oxygen lancing has provided means of speeding up relining of blast furnaces where the frozen iron in the salamander has to be removed.

Member: I would like to ask Mr. Simon what to do to prevent the rivets from loosening when building up trunnion castings from hot metal ladles.

W. K. Simon: Building up the trunnion should not have sufficient heat effect to loosen the rivets but if they are loose, welding the heads will not help much, as they are already stretched to the point where their strength is impaired.

Neither would it be advisable to supplement the loosened rivets by welding the casting to the shell, as this operation would prevent the movement and flexing necessary due to expansion and contraction of the ladle proper.

As in the case of welded ladle fabrications, the joint between trunnion and ladle should be riveted, both for flexibility and for ease of replacement.

All welding on trunnions in our plant is performed according to a procedure set up by our metallurgical, engineering and welding staffs, involving local preheating, scarfing, magnafluxing, welding, peening and a final visual and magnaflux inspection.

A. Preuss: How many men are necessary for thermit welding?

VERTICAL and HORIZONTAL PUMPS
for all water requirements in steel mills
for low or high pressure—any lift—10 to 220,000 g.p.m.
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● THESE improved attachments resist inward movement, while permitting movement in all other directions. The plate is free to move with the stack during expansion and contraction.

Cooling plate cast without long necks—water pipes replaceable. Latest construction.

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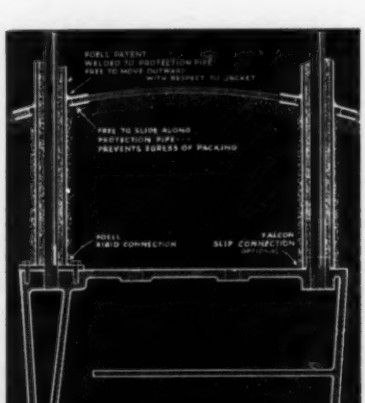

Made with feed and discharge adjacent or at opposite ends of plate.

U. S. PATENTS
2,345,188
2,252,685
2,252,606
2,319,571

●

TELEPHONE COLLECT 34355
FALCON BRONZE CO.
YOUNGSTOWN 3, OHIO
Established 1890 . . . Incorporated 1895

W. K. Simon: On smaller jobs we have a man and a helper but on our large jobs we have a thermit welder and two helpers who line up the pieces, put on the wax pattern, build the mould and perform all the work necessary to make the weld.

In the largest thermit weld we have made it was five days from the time the spindle was set up and the parts setup, working only day turn.

K. A. Daugherty: The work they are doing at South Works, and the size of some of the jobs, are outstanding. Our experience at Gary Works of National Tube Company has been limited mostly to thermit welding of crane runway rails.

In the preheating state, we are not quite sure when the rail is ready for the thermit. If the rail is allowed to get too hot, it is liable to anneal; if not hot enough, the weld will not penetrate or fuse properly. Is there any other method used except visual observation in determining the proper temperature?

W. K. Simon: On the thermit welding of rails it is pretty difficult to determine, especially out in the open, just exactly when you have brought the ends to be welded up to the proper preheat temperature. Ordinarily, most of our welding is done in a shop, although we have done quite a bit of thermit welding of rails. However, in a subdued light, the temperature shows up more readily. We have on occasions obtained a pyrometer to check our temperatures, especially on the pouring of cast iron rolls where the temperature is a little bit lower if anything. Normally, we strive for 1500-1600 F on the preheat and in the case of cast iron that drops down a couple of hundred degrees. An experienced thermit welder, by looking at his job, can tell within 100 degrees what the temperature is, and I don't believe that variable will really affect the weld.

As far as lack of penetration is concerned, I have yet to see a weld that was not penetrated sufficiently, although I have seen a lot of them that contained sand or slag or gas pockets. The gas pockets, of course, can be caused by pouring the thermit into a damp mould or one that is not thoroughly ventilated.

Our biggest problem is the annealing effect adjacent to the weld rather than the lack of penetration.

K. A. Daugherty: How long a period of time is allowed after the weld is made before stripping the mould from a rail job?

W. K. Simon: We strip it off in ten to fifteen minutes. We try to strip it while it is still red hot so we can cut off the risers and cut any fins that might exist by means of a cold chisel and sledge hammer.

K. A. Daugherty: No harm is done in that way?

W. K. Simon: None that I know of. As soon as the heat of the weld soaks into the rail, you will get an annealing further back on the rail section. Exposure to air cools it much more rapidly than if you leave the mould on, thereby reducing the annealing effect. There is also a considerable savings in time by this method of stripping the mold, which makes it possible to move to the next joint in a minimum amount of time.

SOME PRODUCTION AND MAINTENANCE *Instruments*

. . . . describing four instruments which have found considerable application in manufacturing plants . . . .

by Clyde S. Cassels

MECHANICAL ENGINEER

HENRY DISSTON & SONS, INC.

PHILADELPHIA, PENNSYLVANIA

▲ THERE are many instruments used continually by steel engineers which are quite familiar. This paper however, will describe four instruments which may not be quite so well known. Three of these are production instruments used in connection with the inspection of work in progress or after completion. The fourth is a maintenance instrument.

The first production instrument to be considered is the profilometer. It is used for the measurement of the quality of the finish on a metal surface. The trend in modern design is toward finer, more accurate and more uniform finishes. With the growth of this demand for better finishes, there developed a need for an instrument to accurately measure them. The profilometer is one of several machines produced for this purpose.

With surface measuring instruments, the character of a surface can be measured accurately and consistently. Therefore, they permit the accurate specification of a finish by the design engineer, and eliminate to a great extent the variations obtained when finish specifications consisted of a word description such as "machined," "rough ground," "lapped," etc.

The surface of any finished piece is composed of a series of hills and valleys which have been produced by the finishing tool. The character of the surface is dependent on the depth and frequency of these scratch marks. The profilometer measures the depth and frequency of these marks, averages the findings, and indicates this average to the operator.

Figure 1 shows the panel of the profilometer. The switch to the left sets the instrument for a range suitable to the surface being examined. On the dial in the center is indicated in micro-inches (R.M.S.) the character of the finish on the piece being checked. Lying on the white strip at the top is a hand-operated tracing arm. In use, this is set on the work so that the two semi-spherical feet, seen at the left, rest on the area to be examined. A diamond tracing point supported on a vertical shaft projects downward between these feet and contacts the work. To obtain a reading, the tracing head is moved either by hand or mechanically back and forth over the work in a steady and uniform manner. Figure 2 shows more clearly the tracing head in position on a piece of hardened and ground steel plate. This is a mechanically operated tracing head. It is moved back and forth at a uniform rate by the power unit, part of which can be seen at the left of the picture. The dial on top of the tracing head is used to lower the tracing point to the work after the head is in position.

When the diamond point is moved across a piece of work, it drops into the valleys caused by the scratches and lifts over the ridges. This vertical movement of the tracing point shaft sets up minute electrical currents in the small solenoid through which the upper part of the

Presented before A. I. S. E. Philadelphia District Section Meeting, April 7, 1945.

Figure 1 — One type of instrument used for the measurement of the quality of finish on a metal surface.

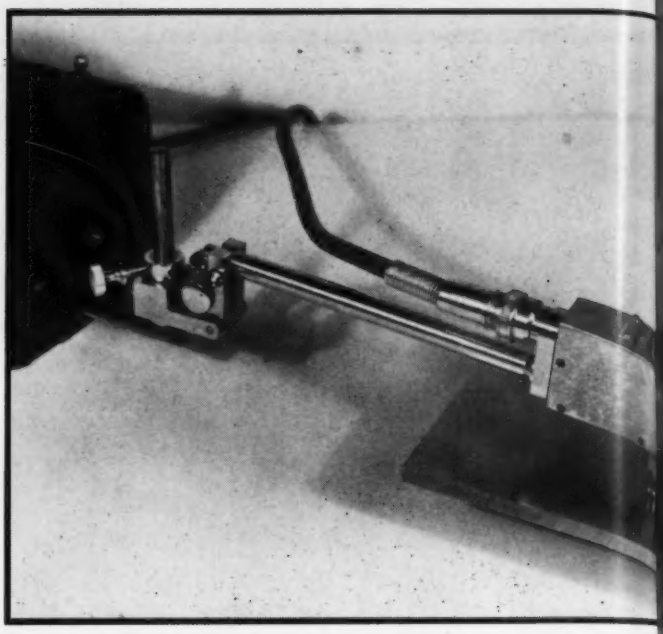

Figure 2 — This mechanically operated tracing head, used with the instrument shown in Figure 1, carries a diamond point which explores the surface under investigation.

shaft moves. The profilometer magnifies and averages these minute impulses, indicating the result on the center dial shown in Figure 1.

When a finish has been specified in micro-inches (R.M.S.), the resultant work can be easily and quickly checked on this instrument. Thus, the same quality finish can be obtained from several sources with the certainty it will meet specifications. When the old method of describing a finish was used, a purchaser buying finished material from several sources had to hope similar work would be turned out by different inspectors who must depend on visual or tactile comparison when making their examination.

The second production instrument to be discussed is another one used for the inspection of steel products which are made to close tolerances. It is the pneumatic comparator shown in Figure 3. We use this instrument for checking the flatness and thickness of some of our jobbing shop products like the ring shown on the slide. Basically, this instrument consists of a fine bore nozzle which directs a stream of air against the work being examined. The stream of air is the measuring medium and does its work very efficiently. The action of the gauge is fundamentally very simple. Work placed beneath this nozzle for checking obstructs the free flow of air from the nozzle and the back pressure thus set up changes the air pressure within the measuring instrument. What the gauge really measures is the change in pressure caused by the increase or decrease of the distance from the nozzle to the work.

When the instrument is being set up, a gauge block is used for calibration. The instrument head is lowered toward the gauge block until the back pressure set up has moved the pointer to the zero mark on the dial. The instrument is then locked vertically in this position. The standard gauge block is removed and a piece of work inserted. If the work is the same thickness, or rather, if the top of it is the same distance from the nozzle as the gauge block was, the needle will register zero. If the work is lower than the gauge block, the obstruction to the flow of air is less and the needle will swing toward the left or minus side of the dial, thus indicating a piece thinner than standard. Correspondingly, a thicker piece, offering more obstruction to the flow of air, will cause the needle to swing to the right or plus side. This, of course, only gives a true indication of thickness if the bottom of the work is in perfect contact with the table.

In testing a ring for flatness, it is laid on the table of the instrument under the nozzle in such manner that when the table is revolved, the ring will pass under the nozzle. Any change in the relative vertical position of the ring with the nozzle is indicated on the dial. The instrument as shown in this figure is set up for a tolerance of plus or minus .001 in. In checking rings, the operator would merely watch for the indicating needle to pass either of the preset limit needles. If the indicating needle stayed between the two limiting needles, the operator would know the ring was acceptable for flatness.

Many applications of this air-jet principle are possible. Thickness can be tested by passing the work between two opposing air jets. Internal or external diameters of tubes, gun barrels and the like can be measured with the use of fixtures mounting several jets. In all cases, the fundamental principle of back pressures within the instrument is the same, but the jet position, size, and air pressures used vary with the individual application. In our case we find that highly finished rings can be checked for flatness without the use of feelers and without the necessity of the measuring instrument actually touching the work, thus eliminating the possibility of scratching. In this type of work, very small nozzles with low air pressures can be used, removing

any possibility of the pressure of the air distorting the work.

The instrument shown in Figure 4 has a purpose which may be thought quite foreign to the manufacture of steel. It is a gauge for measuring the moisture content of wood. Uniformity of the wood used for the manufacture of handles for saws and other products is important. It must be delivered to the wood working department in as consistent condition, month in and month out, as is possible. This means, among other things, that the moisture content must be accurately controlled. A large percentage of our wood is received as logs and is sawed, steamed, air dried and kiln dried in our lumber yard. In the final kiln drying of the wood, it is important that the lumber yard superintendent be able to obtain quickly, easily and accurately, readings on the moisture content of the lumber in process. Wood may be put into the kiln having as high as 20 per cent moisture, which must be reduced to 6 per cent before the wood is ready for use. The drying cycle takes about five days. The kiln action involves the application of heat and moisture in controlled quantities which are varied as the wood dries. One old method of determining the amount of moisture in a given piece of wood was to cut a sample to uniform size, weigh it accurately, dry it on a steam radiator for 24 hr and again weigh it. From the difference in weights, with the volume known, a fairly accurate idea of the moisture content could be obtained. However, by the time the results were known, conditions in the kiln would probably be quite different from those existing when the sample was taken, due to the elapsed time. The instrument shown here enables the operator to take a reading of moisture content with accuracy sufficient for our requirements.

This instrument is powered by battery. The two switches shown on the left hand side control the application of the current and the range of the meter. In practice the leads of the contactor, two types of which are shown in the figure, are plugged into the jacks at the lower left hand corner of the meter and the contactor is pressed on or into the sample to be tested. The contactor shown lying in front of the meter is equipped with ten needles which penetrate the surface of the wood. The one shown in the background on the piece of wood is built up with two flat contact bars instead of needles and is used where it is desired to read the moisture content at the surface of the wood and can also be used on finished products where the needles would injure the surface.

When the needles have been pressed into the wood, current flows through it from one set of needles to the other, completing the electrical circuit and causing a movement of the indicating needle. The amount of current flowing and consequently the amount of movement of the needle varies with the quantity of moisture in the wood and also with the character of the wood itself. This instrument is not direct reading and the position of the needle on the dial does not show directly the moisture content of the wood. The manufacturer of this particular instrument believes that less variables are involved if the moisture content is determined through the comparison of the amount of current flowing through the sample with the amount of current passed through one of several fixed resistances built into

Figure 3 — The pneumatic comparator checks flatness or thickness of objects through the change in pressure of air jets directed against the piece to be checked.

▲

Figure 4 — The moisture content of wood is determined by this instrument which measures current flow through the wood.

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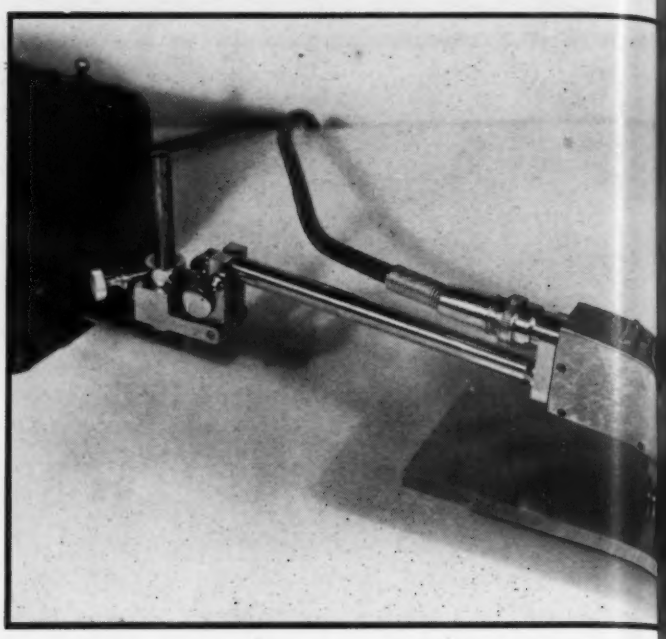

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OHIO
Extra Strength
MAGNETS

A 55" Double strength magnet.

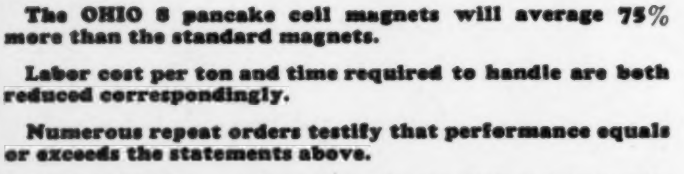
The OHIO 6 pancake coil magnets in the 55" and 65" diameters will average 35% better lifts than the standard magnets.

The OHIO 8 pancake coil magnets will average 75% more than the standard magnets.

Labor cost per ton and time required to handle are both reduced correspondingly.

Numerous repeat orders testify that performance equals or exceeds the statements above.

★When OHIO magnets are required to lift hot materials the heat resisting bottom construction shown below successfully retards the flow of heat from the load to the magnet coil and permits all day use.



"D" MANGANESE BOTTOM PLATE
"R" ASBESTOS GASKET
"R" MAGNET FILLING COMPOUND
"V" HIGH TEMPERATURE HEAT INSULATION

Have you a problem requiring fast lifting or lifting of hot steel?

The OHIO Electric Mfg. Co.

5907 Maurice Avenue Cleveland 4, Ohio

the instrument. Thus, when a dial reading has been obtained and without any change in the setting of the instrument the contactor is removed from the wood and touched to one of the fixed resistance plugs shown across the bottom and up the right hand side of the instrument panel, the resistance which causes the needle to come nearest to the position it held when the contactor was in the wood is the one whose number indicates the moisture content of the wood.

In our work, readings taken in this manner are sufficiently accurate without correction. Where fine accuracy is required, especially in the higher ranges of moisture, correction factors must sometimes be applied. These factors depend on the species of wood being examined, as different woods affect the flow of current in different manners and cause variations in the readings not directly related to the quantity of moisture present.

The last instrument to be discussed is a maintenance instrument. It is called a strobotac. As its name implies, it is a combination of a stroboscope and a tachometer. It consists of a flashing lamp, the frequency of which can be varied. Our instrument has a range of from 600 to 14,400 cycles per minute and can therefore be used to stop motion and measure speeds within those ranges. It is operated on 110 volt, 60 cycle alternating current.

We use it for the determination of the speed of revolving objects which, due to their shape, size, or location, cannot be checked easily with a standard tachometer. We also use it for examining machines or parts of machines while in motion. To obtain the speed of a revolving object, the frequency of the flashes of light emitted by the neon tubes is varied until the revolving object appears to stand still. A dial and pointer on the top of the instrument show at all times the frequency of the flash. When the speed of the flash corresponds to the speed of revolution of a distinct point on the revolving object, motion of that point appears to stop. The frequency shown on the dial is then equivalent to the rpm of the object being examined.

One caution must be observed in connection with the use of an instrument of this type. Motion will apparently be stopped when the strobotac is operated at certain speeds greater than the actual speed of the revolving body, but multiple images of the point being watched will appear. Motion will also appear to stop when the strobotac is operated at certain speed slower than that of the revolving body, but in this case the image of the point being watched will not be clear and distinct. The safest method is to start with speeds known to be well above that of the revolving body and slow down the strobotac until the first single, well defined image is observed. The speed of the strobotac flash at that time will be equivalent to the speed of the revolving body.

We find we can use this instrument in subdued light satisfactorily but operation is difficult in bright daylight. It has, however, proved useful in checking the speeds of grinding and cutting wheels, chain saw motors, and other similar applications.

Refractories

PERFORMANCE RECORDS

. . . . records of performance are necessary to evaluate the various refractories . . . . they aid in the design of furnaces and provide a guide for research in the development of improved refractories . . . .

by Mervin A. Fay

CERAMIC ENGINEER

BETHLEHEM STEEL COMPANY

SPARROWS POINT, MARYLAND

▲ REFRACTORIES performance records can be a valuable tool for steel plant operators, in that the records can be interpreted to show many things besides difference in service life obtained from different refractory materials. Such records are of primary importance in themselves as guides in the purchasing of the most economical refractories. In addition, they can show the relative values of different furnace designs from a maintenance stand point, they can be an aid to engineering departments in the design of new equipment and they can be used to direct research toward the development of new or improved refractories for the places which most need them.

Most steel plants have some refractories performance records kept by operating, accounting or maintenance departments. However, these are seldom correlated and in many cases, the records kept are misleading. For example, the hearth of a heating furnace may actually be giving more service during six months than a similar installation did in twelve months, five years ago when operating rates were low, yet records based on the length of time between hearth replacements would indicate the opposite. Such records are worthless. If these records had been kept on the basis of tons of steel heated, they would have been comparable and would show the relative value of the two installations. This information, accompanied by data on the amounts of refractories used, the extent of repairs made, the sources of the refractories, analyses of any properties indicative of brick quality, the causes and locations of failures, and the amount and cost of delays resulting from the failures, could be interpreted for use by management in any of the aforementioned applications. Good refractories performance records include all these things, and should be kept on all steel plant furnaces.

The records kept on different furnaces will depend on the nature of the operation. In general, wherever the most refractories are used, the most detailed records should be kept. The records for furnaces using large amounts of refractories and requiring frequent repairs should be detailed, showing the service life of the various furnace parts separately. Open hearth furnaces are a good example of this type. The records for furnaces using large amounts of refractories but requiring infrequent repairs should also be detailed, but with more emphasis placed upon the quality of the brick used and on the causes of failures. Blast furnaces and coke ovens are good examples of furnaces requiring this type of record. The records for furnaces using comparatively small amounts of refractories and requiring infrequent repairs do not need to be as elaborate as the other two types. However, in furnaces of this type, if some one

Presented before A. I. S. E. Philadelphia District Section Meeting, April 7, 1945.

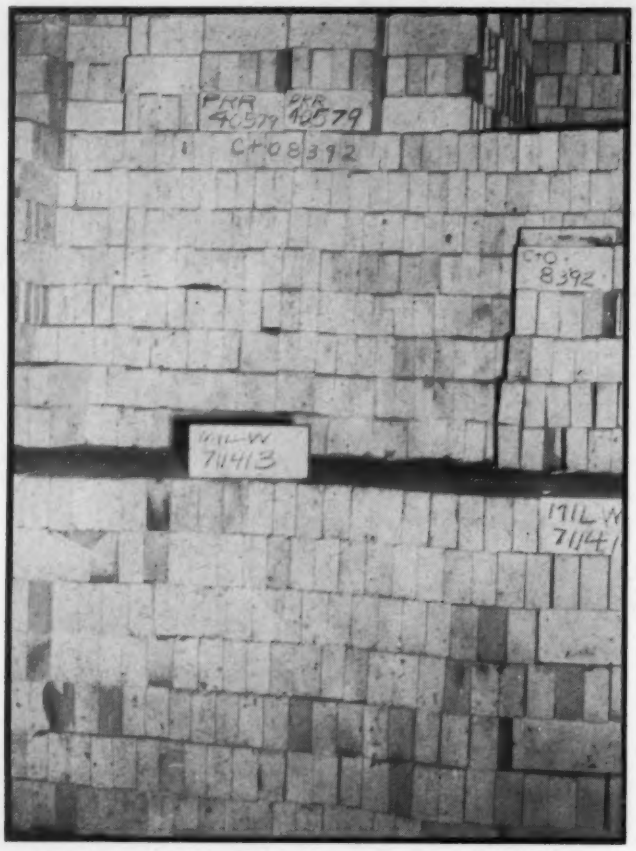


Figure 1 — Bricks in storage are segregated as to brand and are marked with the incoming railroad car number.

part requires frequent repairs, detailed records of the life of this part should be kept. Most mill heating furnaces fit into this category.

The foregoing discussion briefly outlines the component parts of an adequate system for recording the performance of refractories. At first glance it appears that a large amount of work must be done to collect this information. On closer examination, it is frequently found that much of the information is already recorded and is readily available. Usually, little additional work must be done to set up complete performance records.

In order to show this and to illustrate such a system of records, the system we have set up at the Sparrows Point plant for complete coverage of the performance of refractories in our open hearth furnaces will be outlined.

The data used in compiling the records come from several different sources. These data must necessarily be collected in some central place for correlation and interpretation. At Sparrows Point this is done by the ceramic engineer. It is a logical function of this position and should be one of its major duties. Intelligent interpretation of refractories performance records requires a knowledge of the physical chemistry of the materials involved, an understanding of statistical analysis of data, and an understanding of the engineering, construction and operating problems encountered in the various furnaces.

The first data needed are the amounts of brick installed during rebuilds and hot repairs of individual furnaces. At Sparrows Point this information is collected by the piece rate department for payroll purposes and for figuring the brick inventory. A copy of this information is also forwarded to the ceramic engineer for calculating refractories performance. At other plants where piece rate departments do not perform this function, information of this sort is usually available from brick or accounting departments where it is recorded for calculating brick inventory.

The next data needed are the sources of the various bricks used. This requires that shipments of brick be followed from the time they arrive in the plant until they reach their final destination in the furnace. At Sparrows Point, this is done by segregating the bricks according to brand at the storage sheds, and by marking brick hacks with the car numbers of incoming shipments as they are unloaded (see Figure 1). When the bricks are loaded for shipment to the open hearth, the car numbers marked on the bricks loaded are noted and forwarded to the ceramic engineer on the form shown in Figure 2. This work is done by the foremen at the brick storage sheds. The installation of the bricks in the furnace is reported by the brick department foreman in charge of the installation; he fills out and forwards to the ceramic engineer the form shown in Figure 3. By comparing these two forms, the source of the bricks installed in each furnace can be readily identified.

Next are needed the analyses of properties which are indicative of the quality of the refractories. This requires some brick testing. However, tests run on samples of brick from delivered shipments are frequently of little value because in many cases the bricks have been installed in furnaces before the test results can be reported. It is desirable that testing be done before the bricks are shipped to the steel plant. This could be best

O. H. FURNACE ROOF INSTALLATION

SPARROWS POINT PLANT — BRICK DEPARTMENT

Date.....
O. H. No.....
Furnace No.....
Brick Cars Used:
North End of Main Roof B. S. Co. No.....
South End of Main Roof B. S. Co. No.....
Dividing Point Between These Cars.....
Port Roofs B. S. Co. No.....
Brand of No. 1 Wedge Bricks in:
B. S. Co. No. 3196.....
B. S. Co. No. 3600.....
B. S. Co. No. 3606.....

.....
Foreman

Figure 2 — Form used by brick storage foreman to report brick moved out to the open hearth.

▲

O. H. FURNACE ROOF BRICK CAR LOADING'S

SPARROWS POINT PLANT — BRICK DEPARTMENT

Date.....
B. S. Co. Car No.....
Brand of No. 1 Wedge Brick in Car.....
Date Sent to O. H.....
Requisition No. CC..... Date Rec'd.....

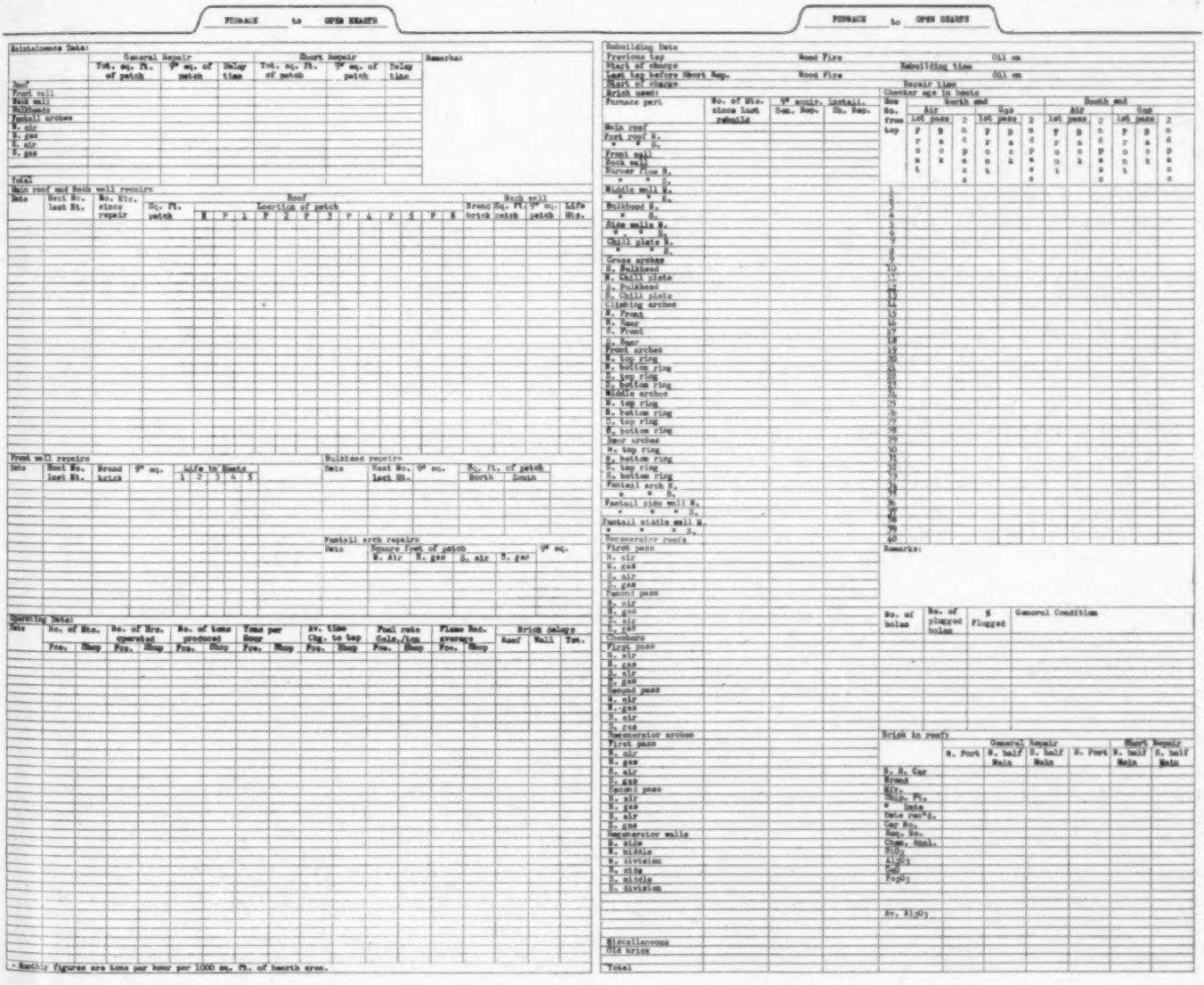
.....
Foreman

Figure 3 — Form used by brick department foreman to report brick used in open hearth roof.

Brick	Silica			Semi-Silica	3rd Quality Clay	2nd Quality Clay	1st Quality Clay			Super Duty Clay	High Alumina	Magnesite	Chrome
Usage	Coke Oven	Open Hearth	General	General	General	General	Blast Furnace	Open Hearth Checkers	General	General	--	--	--
Chem. Anal.													
SiO_2							x			x	x	x	x
Al_2O_3	x	x	x		x	x	x	x	x	x	x		x
CaO	x											x	
MgO												x	x
FeO	x						x					x	x
Fe_2O_3	x						x					x	
Cr_2O_3													x
TiO_2	x	x	x										
Na_2O	x	x	x	x	x	x	x	x	x	x	x		
K_2O	x	x	x	x	x	x	x	x	x	x	x		
P.C.E.				x	x	x	x	x	x	x	x		
True Sp. G.	x	x	x		x	x	x	x		x	x		
Bulk Sp. G.					x	x	x	x		x	x		
Porosity					x	x	x	x		x	x		
Physical Size							x	x					
Cold Crushing Strength							x	x					
Modulus of Rupture							x	x					
Resistance to Deformation under Hot Load				x			x	x		x	x		
Resistance to Spalling									x	x	x		
Resistance to Shrinkage							x	x	x	x	x		
Resistance to Slag Attack								x	x	x	x	x	x
Resistance to Carbon Disintegration							x		x				

Figure 4 — Chart showing critical properties of various refractories (x designates properties which are critical).

Figure 5 — Data sheet (two sides) used for tabulating all refractory information on rebuilding and maintenance.



BETHLEHEM STEEL COMPANY
SPARROWS POINT PLANT
OPEN HEARTH REFRACTORIES PERFORMANCE

ROOFS

Campaigns Completed

Furnace Number	Total No. of Heats	No. of Roofs	Heats per Roof	Brick Brand	% Al_2O_3	Remarks
Average						

Patching

Open Hearth	Average Heats to First Patch		Average Heats - First Patch to Second Patch	
	No. Patches	No. Heats	No. Patches	No. Heats
#1				
#2				
#3				
Average				

FRONT WALLS

O. H.	Door Position 1		2		3		4		5		Average	
	No.	Life	No.	Life	No.	Life	No.	Life	No.	Life	No.	Life
#1												
#2												
#3												
Avg.												
#1												
#2												
#3												
Avg.												
#1												
#2												
#3												
Avg.												
#1												
#2												
#3												
Avg.												
#1												
#2												
#3												
Avg.												

Figure 6 — Form used in reporting correlated results of refractories performance.

accomplished by having the brick manufacturer furnish the results of his manufacturing process control tests on individual shipments of brick. This practice has not been followed customarily in the past but might well be a normal practice, just as the steel industry furnishes chemical analyses and the results on physical properties of steel to customers. The brick manufacturer might report the results of his control tests to the ceramic engineer regularly, marking the shipping notices of individual shipments of brick to show the control tests applicable to them. This practice would reduce the testing of brick at the steel plant to the checking of manufacturers' tests.

In connection with the general subject of brick testing, it should be remembered that bricks included in one shipment will vary considerably in properties, and as a result, the average of the shipment does not always tell the whole story. A brick installation is only as refractory as its least refractory member. Thus, one shipment may contain many bricks which will fail in service because of the variation in some critical property, even thoughthe average of the shipment is satisfactory with regard to that property. For this reason composite samples, that is samples of many bricks combined into one sample for testing, are of little value. Consecutive spot samples, even though few in number, will yield more information than an equal number of composite samples, provided the results are analyzed intelligently. Statistical analysis is helpful in the proper use of this data.

It should also be remembered that bricks for different applications have different critical properties which determine their relative quality. It is not necessary to determine all the properties of a brick to show its quality. If the application of a brick is known, its testing need not be excessive. Figure 4 shows some of the critical properties for various bricks in specific applications.

The remaining data needed to complete the refractories performance records are chiefly operating data which can be obtained readily from operating departments. At Sparrows Point, the open hearth operation records show the tonnages of steel made between repairs and the amount of delay time to accomplish these repairs. In addition, a record is kept by the open hearth department of the locations of failures in furnace roofs, front walls, etc. on individual furnaces. This information is reported to the ceramic engineer.

The ceramic engineer then has all the requisite information for complete refractories performance records. This information must be correlated, tabulated and interpreted to show the relative value of different bricks, furnace designs, etc.

For this purpose we have adopted the data sheet shown in Figure 5 for tabulating all the gathered information. One side (left) shows the details of work done during major rebuilds and gives a picture of the condition of the furnace at the start of a campaign. The other side (right) shows the details of repairs made to the furnace during operation and operating data.

To interpret these data and to make it possible to compare the performances of different furnaces and the performances of different bricks in one application, it is necessary to reduce the data to a comparable basis. The most logical basis for such comparisons is the volume of brickwork consumed per ton of steel produced, or some function thereof. At Sparrows Point this is done for each furnace part, such as main roof, port roofs, front walls, bulkheads, side walls, fantail arches, checkers, checker roofs, etc. In each case the life is considered as the length of run between complete replacements of the furnace unit, with allowance for the hot repairs made. For example, the main roof life is considered as the number of heats between complete replacements of the main roof divided by the number of roofs installed during this period. The number of roofs installed is calculated as the 9 in. equivalent of bricks in the original main roof plus the 9 in. equivalent of bricks in hot roof patches divided by the 9 in. equivalent of a 13½ in. thick main roof of the same size; this latter figure is chosen because 13½ in. thick roofs are more or less standard in our company.

Another example of this method of comparison is the calculation of front wall life. The front wall life is considered as the average of the number of heats between

replacements of individual door arches and jambs, five of which make up a front wall.

Figure 6 shows the form used in reporting these values.

In each of the above cases, the life value is reported in terms of heats per unit. This figure is reported because it is a term familiar to open hearth operators. In both cases the figure can be converted to 9 in. equivalent of brick consumed per ton of steel produced, or to pounds of brick consumed per ton of steel produced, by a factor which is dependent only upon the size of heats made and the 9 in. equivalent or weight of bricks in a standard furnace unit. For furnaces of equal size and similar operation, the figure reported is comparable, but in order to make comparisons of different style furnaces with different operations, the converted figures must be used.

Summarizing the foregoing, a system of recording refractories performance which incorporates data on quantities of bricks used, quality of bricks used, furnace operation, the causes and locations of failures, and the delays resulting from failures has been organized. The collection, correlation, and interpretation of all these data yield a complete, integrated record of refractories performance. The utility of these records is obvious:

1. They can be used in determining which refractories are best suited for specific applications.
2. They can be used in disposing of substandard refractories in the way which causes the least damage.
3. They can be used in determining the advantages of one furnace design over another.
4. They are a guide in the design of new furnaces.
5. They are a guide in studying furnace operations.
6. They are a guide for research toward the development of the most needed new or improved refractories.

DISCUSSION

PRESENTED BY

MARTIN J. CONWAY, Manager, Petroleum Division, Lukens Steel Company, Coatesville, Pennsylvania

W. N. HORKO, Engineer, Henry Disston and Sons, Incorporated, Tacony, Philadelphia, Pennsylvania

F. H. SPIESS, Fuel Engineer, Alan Wood Steel Company, Conshohocken, Pennsylvania

ALEX SWANBERG, Mason Foreman, J. A. Roebling Sons Company, Roebling, New Jersey

JOHN S. MORRIS, Methods Engineer, By-products Steel Corporation, Coatesville, Pennsylvania

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

R. R. FAYLES, Assistant to Open Hearth Superintendent, Lukens Steel Company, Coatesville, Pennsylvania

WALTER FLANAGAN, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania

W. J. NICE, Chief Engineer, Vacuum Conveyor Company, Philadelphia, Pennsylvania

M. A. FAY, Ceramic Engineer, Bethlehem Steel Company, Sparrows Point, Maryland

Martin J. Conway: Mr. Fay has delivered an excellent paper. From a bookkeeping standpoint it leaves little to be desired. However, there are naturally some data not included in the paper on which we would welcome some further information.

I would like to know the extent of the refractory saving, in 9 in. equivalent per ton of steel made, on the open hearth furnaces since this method of refractory use analysis has been in practice, and if obtainable for some period prewar. If there is no long period prewar in which this method was in use, then I would like to have the figures covering the period the refractory use analysis has been in use, and I would like to have specific information on the particular parts of the furnace which show the greatest improvement in refractory saving due to this analysis.

I was somewhat surprised to note in Figure 4 that the lime content of the silica brick was not important.

W. N. Horko: We keep some performance records at Disston's but since we have no blast furnace or open hearth furnaces our records are not nearly as elaborate as those kept by Mr. Fay. The records we keep are on a time basis rather than on a tonnage basis and by keeping records we have been able to learn the proper type of refractory to use for various parts of heating furnaces. We have one sheet mill furnace which is underfired with oil and which had a first quality fire brick hearth and hearth supporting piers of the same grade. Because of the high temperatures generated in the combustion tunnels under the hearth when heating certain types of material, the pier life was relatively short and it was frequently necessary to remove a hearth which had many hours of life left in it in order to replace the piers under it. We changed from first quality brick to a high alumina brick for the piers and the records showed the change to be a good one, since we now replace the hearth many times without making any repairs to the piers.

Another case which I would like to mention is that of a batch of small furnaces used for annealing and carburizing. The hearths in these furnaces usually lasted six to eight months. We changed from a first quality fire brick hearth to one of silicon carbide and now run up to three years on one repair. When these furnaces were used for carburizing we had to replace the first quality

hearth after three heats. The records show as many as sixty carburizing heats for the same service with silicon carbide.

As Mr. Fay has said, it is very important to keep records on refractory life. The two cases I have mentioned are a few of the things we have learned from keeping records.

F. H. Spiess: Our records on brick life are not as elaborate or kept in as great detail as those just described by Mr. Fay. However, I agree that the more that is known about the brick and its length of life at a definite location in the furnace, the sooner a plant can standardize on brickwork in an efficient way, thus eliminating any questions on the type of brick to be installed.

I would like to ask Mr. Fay if, when he discovers that a certain type of brick is not standing up according to his expectations, he changes the make or type, or if it is possible, does he first change the size?

Alex Swanberg: We keep a record, not on tonnage but on heats, but I would like to hear about roof life. We have obtained 549 heats on the roof of a 45 ton basic furnace, and we are pretty proud of that record; 200 heats used to be good for us on this furnace. We are using basic brick both on the front and back wall, tying them in to the box head with sheet, and we are getting an average of 200 heats on the front wall and 400 on the back wall. We are doing a little better on end walls. We did try basic brick there but did not get very good results, as it cut the silica below the basic quite a bit, so we practically tore down the end walls and carried the basic brick down quite a ways into the slag pockets. I would like to hear something about the dividing line between silica and basic on the end walls.

Member: Was that 549 heats on the roof without a patch?

Alex Swanberg: No, that is with repairs. We replaced about 200 bricks — that is 12-inch bricks, 4½ x 3 in. — in that roof.

John S. Morris: I would like to ask what they have found to be the most desirable alumina content of silica brick, and what effect does alumina have if it varies either up or down from that desirable point.

Another thing I would like to ask is relative to shipments of various cars of brick, probably from the same manufacturer but shipped at different times; is any attempt made to segregate those brick when they are reloaded to ship to the open hearth, or are they mixed up and placed anywhere on the furnace?

Mr. Fay mentioned pounds of brick per ton of steel and also referred to 9 in. equivalent. In computing the pounds of brick, does he use the manufacturers weight for each type or does he convert it to pounds by using the 9 in. equivalent weight?

Member: They have double-pass checkers at Sparrows Point and I understand they are getting several thousand heats out of the checkers. That is very good, particularly out of double-pass checkers. I would like to hear something about that.

F. C. Schoen: Anything that we can do to cut out repairs, or reduce the amount of labor necessary for repairs, is very important. If you are able to determine the life of brick on a normal burnout of a furnace, or normal failure, that information is very valuable. I don't know what kind of crane operators or manipulators are used in the author's plant, but we don't seem to keep a wall in long enough for it to burn out naturally. As a result of such conditions, it has been hard to compare one brick as against another, and one furnace as against another. We can build a furnace up with one type of brick and take record of it, but if the walls or roof are knocked down, what do we know? In our plant, the only thing we have experimented with is roofs of some of the heating furnaces, trying two or three courses of different types of brick, and when the furnace is knocked down or fails, you have at least some evidence of which is the best type of brick to put in. I would like to hear a little more about this type of test, and the author's experience with failures due to other than normal burnouts.

R. R. Fayles: I would like to ask if Mr. Fay feels that the pounds of brick per ton of steel produced can be used as a comparative figure for all open hearth shops. Management always compares the refractory performances for open hearths; they have attempted to use this figure as a universal basis for comparison. I would like to know if this is a just comparison, especially when the furnace sizes and melting practices usually differ to a considerable degree.

Secondly, I would like to know if difficulty is encountered in getting this information from the people who handle the brick in the plant. If we had a number of forms as shown in the paper, we would have a hard time getting them filled out properly.

And third, if brick from a certain supplier does not seem to measure up to standard, what action is taken with the supplier and how is the substandard brick disposed of?

Walter Flanagan: In connection with roof life, I assume that it is based on the use of the same quality of bottom materials and the same general grade of steel. If not, what compensation is made for alloys when varying percentages are made in the different shops? Also, do I understand that it is expected ultimately to be able to reject carloads of brick before they are actually placed in the furnace rather than to make complaints or claims for adjustments after brick have failed in service?

W. J. Nice: I am not much of a brick mason or overly familiar with brick practices in the open hearth, but it seems to me there was one point that was overlooked. Mr. Fay stated the furnace wall is as strong as its weakest point. What about the refractory cement used? Is it worth taking that into account, or not?

M. A. Fay: In reply to the question as to the savings of refractories since these records have been set up, we cannot say how much of the refractories savings we have realized since the records were started can be attributed to the records themselves. Some of the changes made in refractories usage which have resulted in better practice would have been made whether or not we had kept the records. Other needed changes in refractories usage were not apparent except as indicated by the records, and have caused substantial savings. In addition to the actual savings, the intangible gain in learning more about our furnaces and the various bricks used has been definitely beneficial.

The furnace parts which have had the most improvement in refractory life since these records were instituted are roofs and front walls.

Concerning the lime content of silica brick, it is merely meant that the lime content of open hearth silica brick is not as critical a property as it is in coke oven silica brick. The lime content of open hearth brick may vary from 1.75 to 2.50 per cent without noticeable difference in the performances of the bricks, but the lime content of coke oven brick should be held at a more nearly constant value for good results.

The question about what to change to correct poor refractory performance is a tough one. Sometimes changes of both brick material and installation design are needed. In general, I feel that the design should be corrected to favor the refractories first, wherever this is possible. An example of poor design causing refractory failures is found in many hot-metal mixers where brick corners project out into the metal to form the opening for the pouring spout, or where metal is poured into the mixer near a brick wall. Such locations have to withstand much more violent washing action than any of the rest of the lining and naturally fail first. No refractory will stand up well in such designs.

As to the number of heats per campaign for our furnaces, we get 200 to 300 heats per campaign with considerable hot repairs. This is a main roof campaign. The port roofs, end walls, etc., last through two main roof campaigns. Our end walls are all silica brick. We have had no experience with basic brick in end walls.

Our checker life is long. The secret, as far as I can tell, is to just leave the checkers in the furnace. At Sparrows Point, the open hearth personnel decides how many checkers are to be replaced during rebuilds. Of course they know that if you are changing checkers you are not making steel, and they govern themselves accordingly. They insist that the checkers be open and reasonably clean, but do not insist that the checkers have to be of any definite thickness if they are stable and look as though they will run for another campaign.

To answer Mr. Morris's question about the most desirable alumina content for silica brick, I refer him to a discussion on this subject by H. M. Kraner at the 1944 meeting of the A.I.M.E. Open Hearth Committee which is published in their proceedings. In general, increases in alumina content decrease the service life of the brick.

Concerning the segregation of bricks, we do segregate individual shipments of roof bricks but others are segregated only as to brand. For roof bricks, the individual shipments are followed through to their installation in furnaces.

The figure of pounds of brick per ton is calculated from the 9 in. equivalent per ton of each of the different weight bricks. The figure for total brick consumption in either case is not directly comparable for all open hearth shops because of the varying refractory practices, operating rates, etc. However, either figure is better for comparison than heats per campaign or other similar values. Personally, I prefer 9 in. equivalent per ton. I think it offers the best comparisons, but in order to be truly comparable from shop to shop it must be accompanied with cost data, data on operating rates, margin of profit, etc..

In our records, we do not make any allowances for accidental failures of refractories by knock-downs except in very rare cases. The reason for this is that normally you will have as many such accidents with one brand of bricks as you have with another and the overall results will indicate the relative worth of the two bricks. Similarly, we do not make any allowances for varying amounts of alloy steel made in different shops. Comparisons of different bricks must be made on similar furnaces operating under similar conditions. However, the values of brick consumption in two different shops using similar bricks will show the relative refractory practices of the two shops.

Panel type tests have a definite place in any program of brick testing and we use them regularly. They are particularly suitable for tests on small amounts of bricks, and show readily which is the better of two bricks. However, the answer is purely qualitative because the life of only the poorer refractory has been determined. We have not experienced any particular difficulty in getting the information for these records from the various men in charge of brick handling. If the information is recorded regularly on a running record, the recorder can check easily to see that all the information is coming in. If it is not, we go out and dig up the missing data.

The refractory mortar used in any brick installation is important data and should be recorded, particularly if there is any variation in mortar usage. This has not been included in the open hearth records used for illustration because we use comparatively small amounts of mortar, much of the furnace being laid up dry, and because we have standardized on two mortars to be used in specific furnace parts. All variations from this practice are recorded.

In answer to the questions on the disposal of substandard refractories and on rejections, we have no set procedure for handling these cases. Each case is handled separately. We have used some off-quality material in locations where it does the least damage, such as false walls or seals, but we do not like to do this. We expect the refractories manufacturers to throw out their culls before making shipments. The whole subject of rejections is dependent upon the setting up of standards tolerant enough to permit the manufacturers a reasonable amount of latitude, but which will exclude poor quality bricks. Any such standards should define satisactory quality in such a way that there will be no question whether or not the brick is acceptable. Obviously, the setting up of such standards would have to be worked out jointly by the refractories manufacturer and the consumer.

Member: Have you had any experience with the low-alumina brick that is coming out now? Secondly, in testing, have you found any difference between the bonded and burned type of chrome-magnesite bricks?

M. A. Fay: We have not used any of the low-alumina silica brick, which we believe you have in mind.

As to the burned vs. unburned chrome-magnesite bricks, we are now running some tests to compare them. So far, we do not have any indicative data.

CLEANING

Open Hearth Checkers

BY VACUUM

. . . . the application of steam jet vacuum systems in cleaning out open hearth checker chambers and flues has shown marked economies . . . .

*by A. F. Franz**

GENERAL SUPERINTENDENT

WICKWIRE SPENCER STEEL COMPANY

BUFFALO, NEW YORK

▲ THE cleaning of flue dirt from open hearth furnaces has always been one of the most disagreeable, dirty, back-breaking jobs around a steel plant. During the past several years high production rates have had to be maintained and furnaces put back on the line as quickly as possible. With the acute labor shortage it has become increasingly difficult to get men to do this hot, undesirable work. Conditions for removing flue dust vary in every plant, and the man-hours vary accordingly.

At Alan Wood Steel, this operation must be done under rather cramped and crowded conditions. The manholes are on the pit floor level but completely blocked off on the stack side by a brick wall so that the only outlet is by wheeling through congested areas, with low head room, to a ladle placed on the open hearth pit floor, the flue dirt being removed from the flues by a gang of seven to nine men working in bucket brigade fashion hoisting the dust through the manholes and dumping into wheelbarrows for final disposal.

Because of the congested conditions and consequent high manhours, and the increased inability to get labor, we had been experimenting for several years, trying to develop a method that would simplify the operation, reduce man-hours and costs, and remove the highly undesirable brute effort required. The final outgrowth of this experimenting and testing was a steam vacuum conveyor system that works highly satisfactorily.

This system consists of a welded circular receiving tank, 36 in. x 72 in., forming the main receiver with a cyclone attached, a steam exhauster which puts the tank under vacuum, standard steel pipe, cast iron fittings, approximately 60 ft of flexible hose or pipe, a receiving nozzle, and automatic cylinder and piston.

The receiving tank is centrally located to take care of four to six furnaces; a pipeline, from 6 to 4 inches, is run from the tank the entire length of the furnaces to be cleaned. From this line, leaders are run to each furnace. Since the material is of a high abrasive nature care must be taken in piping. Standard steel piping and cast iron fittings are used in most places, special abrasive fittings being necessary at only a few spots.

The tank is put under vacuum by the steam exhauster which is mounted on top of the tank, the steam consumption being controlled by small nozzles. Steam pressures from 80 psi upward at the nozzles (not line pressure) are satisfactory.

Steam consumption based on actual metering is approximately as follows (steam pressure of 125 psi):

Presented before A. I. S. E. Philadelphia District Section Meeting, April 7, 1945.

*At the time this paper was presented, Mr. Franz was general superintendent of Alan Wood Steel Company, Conshohocken, Pennsylvania.

Suction pipe, in.	Nozzle size, in.	Lb of steam per hr
4	1/4	1800
4	5/16	2180
4	3/8	2400
5	1/4	2100
5	5/16	2300
5	3/8	2600
6	1/4	2300
6	5/16	2680
6	3/8	2900

Operation of the system is very simple. With the receiving tank under vacuum the dirt is sucked into the pipe line through a flexible hose or pipe, on the end of which is attached a receiving nozzle. The material is placed into this receiving nozzle by two or more men, depending upon the available room in the flues. When the furnace is very hot on quick rebuilds, spell crews are usually used, and work in ten to twenty minute cycles.

The system is capable of handling as much material as the number of men that can be conveniently employed in the flues can feed the receiving nozzle or hopper. The size of the piping and unit should be determined by the available room in the flues, and the number of men that can work without interference. A 6 in. unit is so much faster that it is by far the most satisfactory when enough room is available to permit men to work. The handling of hot material is no problem — it is not uncommon to take out red hot material. Wet material, however, has a tendency to cake unless about 50 per cent of dry material is added.

The initial experimental unit met with such success and favorable reaction from the industry that further development was turned over to a separate manufacturing company which has already installed similar units in a number of other steel plants, all working successfully. In some cases material has been pulled over 600 ft with a 45 ft lift; in others 300 ft with an 80 ft lift.

Since conditions in every plant vary, the unit must be adapted to the individual plant. The amount of flue dirt that can be removed depends entirely upon the proper organization of the men who operate it and the number of men that can be satisfactorily used to feed it.

Since the material is very abrasive, special abrasion resisting plates are used in the cyclone part of the unit. These plates can be readily changed since the top of the receiving tank is held by bolts that can easily be removed.

One of the most difficult things to overcome in the development of the unit was to keep the exhaust as free from dirt as possible. The light dust from waste heat boilers seems to be the worst offender. After making extensive tests, a secondary cyclone was designed to take care of this. This consists mainly of a small receiver hooked on to the primary receiver, which catches the dirt that would normally exhaust from the primary receiver.

Waste heat boilers are very easily cleaned and shutdown time formerly taken is eliminated which effects a substantial saving in steam costs.

Alan Wood is tapping 125 ton heats, averaging 225 heats per campaign. The dust removed averages approximately 55 tons per campaign. The average time for cleaning by hand was 610 man-hours. This has been reduced to an average of 224 hours, effecting a saving of 386 man-hours, or 60 per cent. The system will readily handle 10 tons per hr if it can be fed to the nozzle. This result is being obtained with a 4 in. pipe line and could be substantially increased with a 6 in. line.

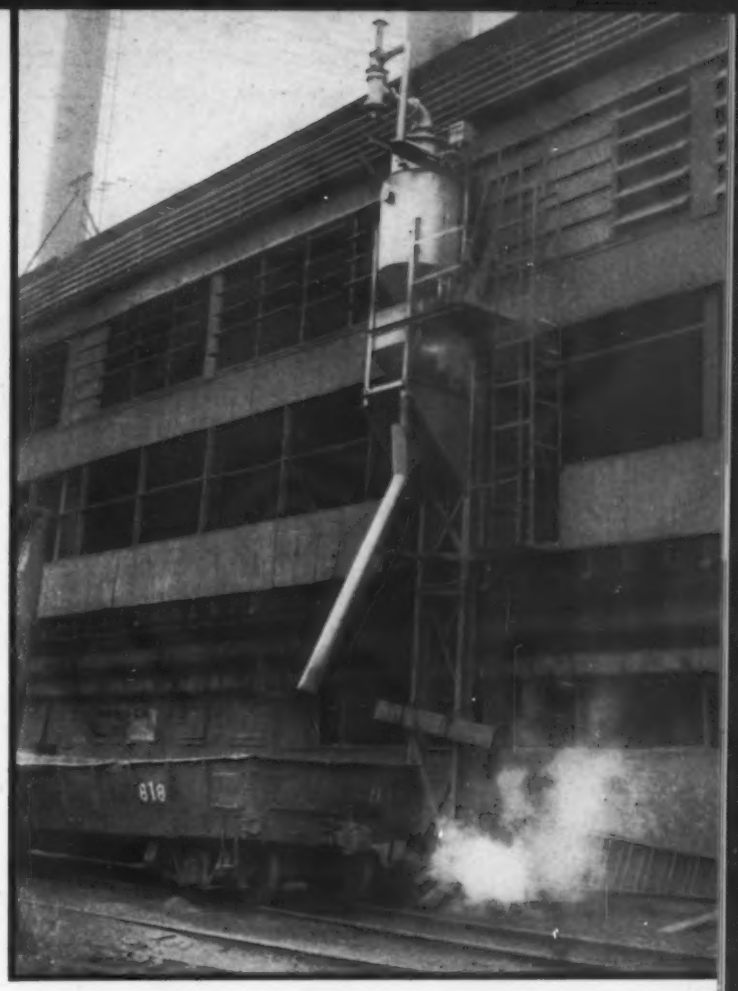


Figure 1 — View of the vacuum unit and dust collector, which automatically empties into cars for ultimate disposal.

The system will readily pick up half of a 4½ in. x 9 in. brick, but this, of course, will clog if crossed in the line. To avoid blocking, small strips are welded across the nozzle-head so that pieces too large cannot be fed into the system. The material is fed into the nozzle head by scoop shovels or hoes, the entire operation being very simple.

The dumping cycle of the receiving tank depends upon the feeding rate. Dumping is controlled by a timer on the steam line which, when shut off, takes the tank off vacuum and automatically releases the hinged door on the bottom of the tank, permitting the material to run into a car or container. As soon as the tank is empty, steam is turned on and the cylinder plunger snaps the door back into closed position where it is firmly held by the vacuum in the tank.

Operating data in other plants are very interesting and show a saving in man-hours comparable, or better than at Alan Wood. They also show a good reduction in

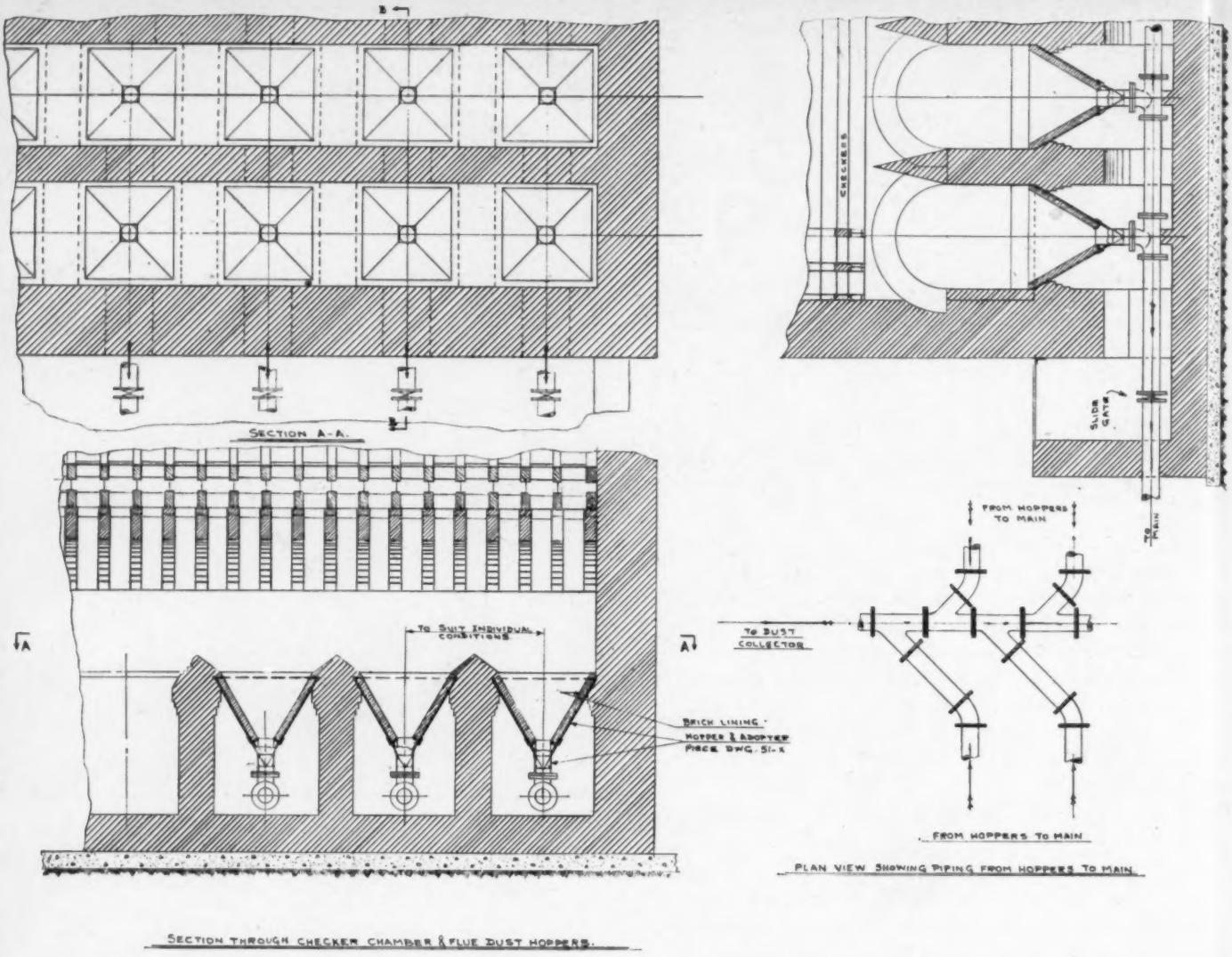


Figure 2 — Sections through open hearth checker chamber, showing installation of permanent vacuum system for use throughout furnace campaign.

elapsed time which permits them to use much needed labor on other parts of the furnace, and leave the flue cleaning until the last. This allows the furnace to cool down considerably and is much easier on labor.

A small portable unit has been developed for a number of other applications. This portable unit consists of a receiving tank 30 in. x 36 in. with the general construction features of the stationary unit, and is mounted on wheels. It is easily moved and can be readily transported from one place to another and used for various purposes, such as removal of scale, fine dirt and dust from checker roofs and various other inaccessible places.

At the present time work is progressing on a permanent installation which will keep the flues clean while the furnace is in operation during the entire campaign. This will maintain clean furnace flues constantly and result in a sharp working furnace.

The results obtained in the use and operation of this system have more than compensated for the effort exerted in its development, and it is felt that, in placing it on a commercial basis, a contribution has been made to the industry at large.

DISCUSSION

PRESENTED BY

R. R. FAYLES, Assistant to Open Hearth Superintendent, Lukens Steel Company, Coatesville, Pennsylvania

WALTER FLANAGAN, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania

GEORGE J. CAMPBELL, Combustion Engineer, Fuel Department, Bethlehem Steel Company, Sparrows Point, Maryland

W. C. SCHULZ, Superintendent Power and Maintenance, Bethlehem Steel Company, Steelton, Pennsylvania

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

A. F. FRANZ, General Superintendent, Wickwire Spencer Steel Company, Buffalo, New York

R. R. Fayles: We think enough of the system that we have purchased one, although it is still in the blue-

print stage. We have made a couple of trial cleanouts with the system and have found that it does not work successfully where the flue dust is damp.

The trial in our No. 3 shop, which has a deeper checker and quite a bit of sub-surface water, showed that the wet dust caked in the collector tank.

However, in our No. 2 shop, which has shallow, dry checkers, the vacuum system worked all right and we are going to install a permanent system in this shop.

Walter Flanagan: I would like to be able to clarify the variation in claims and advance calculations of benefits that should accrue from such an installation as Mr. Franz described. One can readily see that there will be a difference between open hearth shops due to the characteristics of the individual checkers and flues. However, some of the claims are widely at variance.

From what I gather, it seems that one would be safe in saying that it is possible to save at least half of the time that it takes to hoe and haul out manually. What might be expected from a vacuum removal installation in a plant already equipped with steam flue blowers.

Also, I am still a little perturbed on the maintenance end. I have already discussed that angle with a number of people, but I do not know whether any of the installations have been in operation long enough to know the exact life of ordinary pipe and ordinary cast iron fittings with dust that is fairly abrasive. You might give as an analogy the ordinary dust or ash collecting system as applied to boilers. The average ash removal system uses abrasion-resistant pipe and fittings in order to hold maintenance to a minimum, whereas many seem to feel that in the open hearth we are justified in relying on ordinary pipe and ordinary cast iron fittings. Have operations been continued long enough to determine the necessity for the use of abrasion resistant material and renewable liners?

George J. Campbell: We have a system of this type at Sparrows Point, but we have a practice of using a lot of water in our checkers, which cools the checkers off much faster than is ordinarily done and as a result of the wet flue dust, we are not able to use the system as well as we would like.

By wetting down and fast cooling we save time in the reconstruction of the upper part of the furnace.

There is one question I would like to ask. Mr. Franz mentioned that there is a possibility of using the system while the furnace is in operation — that is, the continual vacuum cleaning of a furnace that is in operation. I would like to know how far that has progressed.

Member: What effect will the installation of one of these systems have on the operation and draft of a furnace, particularly if the system is used continually?

W. C. Schulz: We have an installation at Steelton which was originally purchased for 3 furnaces and was since extended to cover 6. We bought it for the purpose of saving labor, as we had to handle flue dust three times: (a) pulling soot to duct inlets, (b) hoisting onto the floor, and (c) loading into cars. Since the installation we have been able to eliminate two of these operations.

We found, too, that we could not wet the soot as was our previous practice, and since have handled it hot out of the checkers directly into the cars.

There is an abrasion problem, and it has been necessary to go to special fittings for the bends, as we found that ordinary steel fittings would not hold up. I understand, however, that the soot in some plants is less abrasive, so the same difficulties might not be encountered, and we may find a difference when we complete the installation to remove the soot from our producer gas fired furnaces.

Another problem, however, is how to hold the dust after we dump it into the car. We find that on a windy day the dust spreads all over the stockyard, and we get a lot of complaint on such occasions from the men on the floor.

F. C. Schoen: We have been thinking about the possibilities of vacuum systems and I am curious about one thing. Our flue dust seems to stick unusually tight in the waste heat boilers. What does this system do to help you out in a case like that? In other cases, such as forge heating furnaces, we fire with powdered coal and we get a lot of slag in the flues, as well as far back in the boiler. Will a vacuum system be of any help in removing such slag? I would also like to know more about the receiving end of these systems.

A. F. Franz: In reply to Mr. Flanagan's question in regard to flue blowers, one advantage offered by the vacuum system is that you don't blow dust out of the stack and all over the plant. In many sections blowing flue dust out of the stack would result in many complaints.

The maintenance question is one that will require time to answer correctly. At Alan Wood there has been some maintenance; but the weak spots were plugged by putting in special abrasion-resistant fittings.

Mr. Schoen stated that most of the dirt is carried out of the stack. Even though a lot of dirt is carried out of the stack, we still get a deposit of dust in the tubes of waste heat boilers. When the tubes are blown this deposit drops into the cleanout space and must be removed approximately every 60 heats.

The former practice was to shut down 4 hours for cooling so that men could get into the cleanout chamber and then another 4 or 5 hours was lost in removing dirt. With the use of the vacuum system it is possible to remove the dirt without a shutdown. This is an important factor where steam costs are high and effects considerable savings.

The receiving head of the hopper might be described as a typical vacuum head, such as on a regular vacuum cleaner. Due to the fact that flue dust cakes and is very heavy, weighing from 80 to 150 pounds per cubic foot, it cannot be picked up without loosening and moving into the vacuum head.

As to the effect on furnace operation, in regards to a permanent installation, I do not feel that any detrimental results will occur as far as draft is concerned. The vacuum system can be used when furnace is tapping. I believe though that it will have to be used more frequently.

Member: What is the relative effect of pipe size on the capacity?

A. F. Franz: I would say that depends a whole lot on how fast you can feed it; where furnace flues are small you can't get more than two men in to do the cleaning. I would say a 6-inch pipe would take out 50 per cent more than a 4-inch pipe. If you have room to get the men in the flues, keep the pipe up to 6 inches, at least. Then you can get it out as fast as you can feed it to the vacuum unit.

FOR MAXIMUM SAFETY AND CONTINUITY OF SERVICE

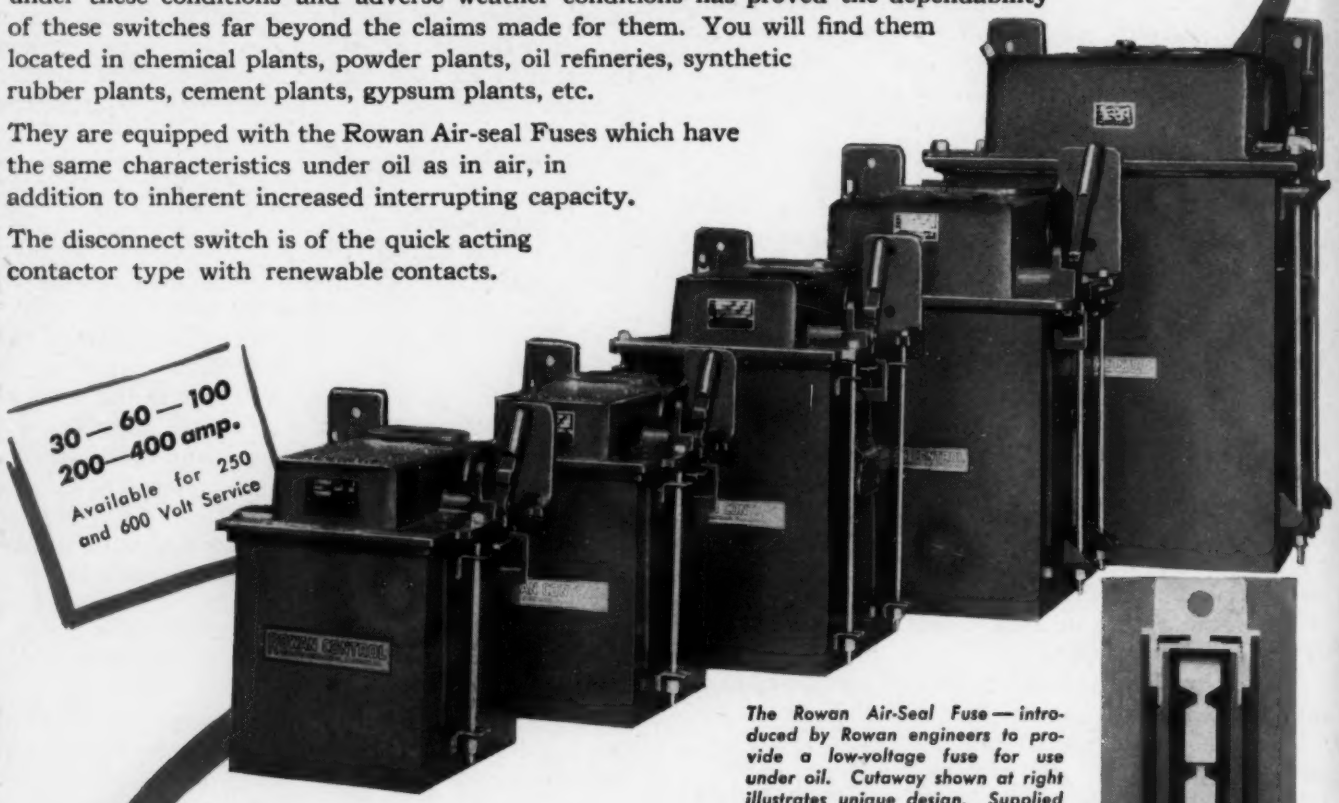
Rowan COMPLETELY OIL IMMERSED, FUSED, SAFETY LINE DISCONNECT SWITCHES

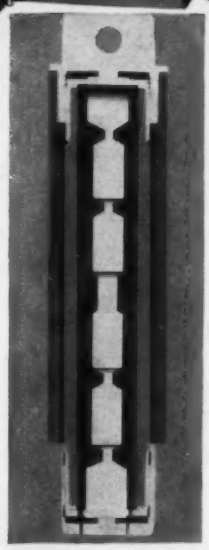
Designed and time-tested for locations where the atmosphere is contaminated with corrosive elements, semi-hazardous and hazardous vapors and dust. Continuity of service under these conditions and adverse weather conditions has proved the dependability of these switches far beyond the claims made for them. You will find them located in chemical plants, powder plants, oil refineries, synthetic rubber plants, cement plants, gypsum plants, etc.

They are equipped with the Rowan Air-seal Fuses which have the same characteristics under oil as in air, in addition to inherent increased interrupting capacity.

The disconnect switch is of the quick acting contactor type with renewable contacts.

30 — 60 — 100
200—400 amp.
Available for 250 and 600 Volt Service





The Rowan Air-Seal Fuse — introduced by Rowan engineers to provide a low-voltage fuse for use under oil. Cutaway shown at right illustrates unique design. Supplied in 30—60—100—200—400 amp., 250 and 600 Volt.

Other features of the Rowan Oil Immersed Disconnect Switch are:

1—ROWAN AIR-SEAL fuses. **2**—Completely oil immersed. **3**—Disconnect switch of the quick acting contactor type with renewable contacts. **4**—Safety enclosing case mechanically interlocked to prevent lowering of tank when switch is in operating position or closing of switch when tank is lowered. **5**—Enclosing case is weather-resisting and dust-tight. **6**—PROVISION for locking disconnect switch in "off" position. **7**—Tank handles for ease of handling.

The Rowan Controller Company has specialized in Oil Immersed Controls for nearly half a century. Results and performance achieved by users justify the Rowan claim of superiority in this field. Write for complete information on Rowan Oil Immersed Controls.

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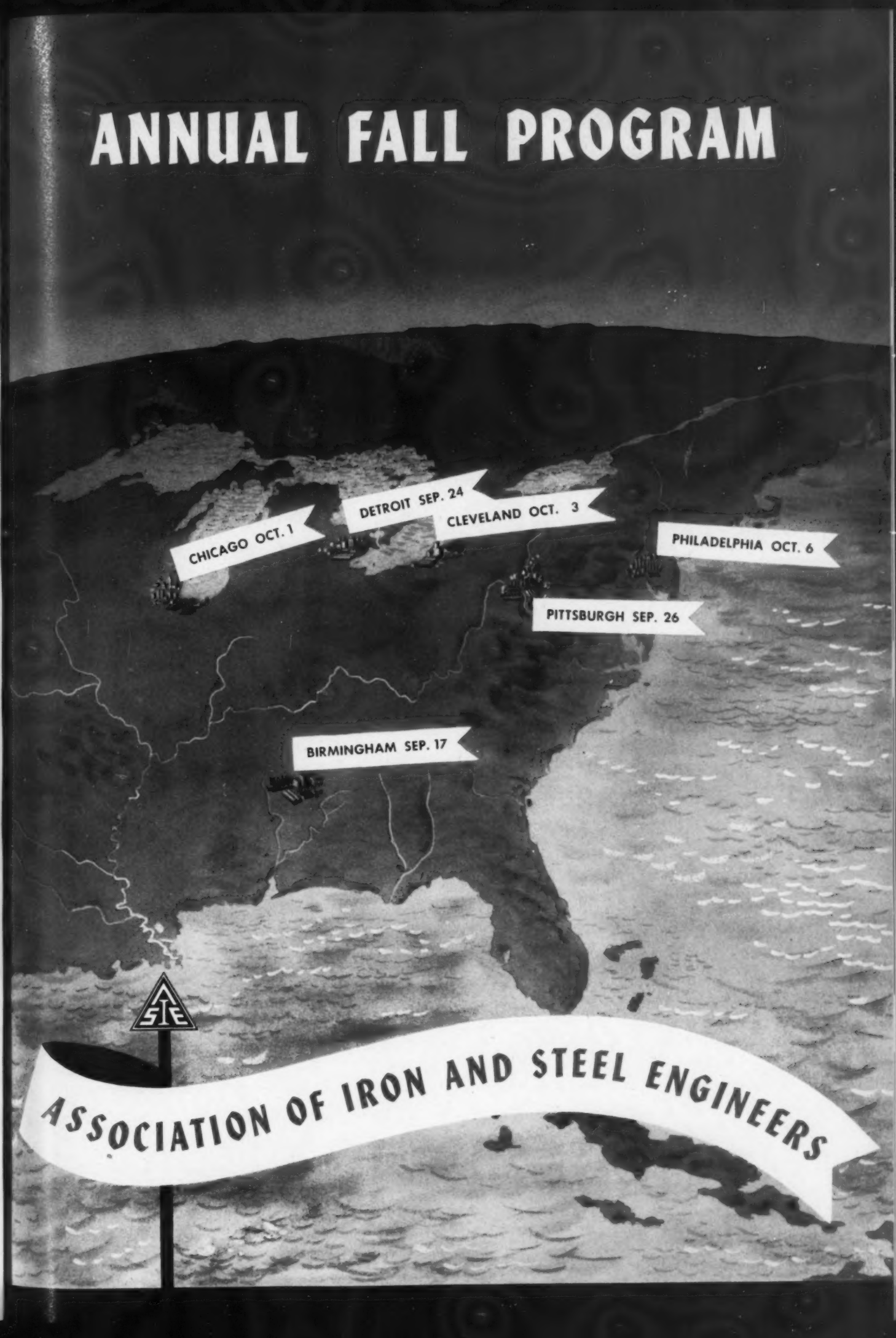
ANNUAL FALL PROGRAM
CHICAGO OCT. 1
DETROIT SEP. 24
CLEVELAND OCT. 3
PHILADELPHIA OCT. 6
PITTSBURGH SEP. 26
BIRMINGHAM SEP. 17
ASSOCIATION OF IRON AND STEEL ENGINEERS

Birmingham

September 17, 1945

Thomas Jefferson Hotel

9:00 a.m. Registration

9:30 a.m. Technical Meeting

"Modern Conveying Systems in Steel Plants," by L. L. Horchitz and Paul W. VanOrden, B. F. Goodrich Company, Akron, Ohio

"The Manufacture of By-product Sulphuric Acid from Hydrogen Sulphide in Coke Oven Gas," by W. A. Leech, Jr., Koppers Company, Inc. and F. D. Schreiber, Pittsburgh Coke and Chemical Company, Pittsburgh, Pennsylvania.

1:30 p.m. Technical Meeting

"Rapid Heating of Steels with Gas Fuel to Heat Treating or Forging Temperatures," by Frederic O. Hess, President, Selas Corporation of America, Philadelphia, Pennsylvania.

"Carbon Products in the Steel Plant," by Frank Vosburgh, National Carbon Company, Inc., New York, New York.

"Blast Furnace Skip Hoists," by Gordon Fox, Vice-President, Freyn Engineering Company, Chicago, Illinois.

7:00 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. A. L. Lemon, Secretary
Birmingham District Section
Association of Iron and Steel Engineers
1722 First Avenue, North
Birmingham, Alabama

Detroit

September 24, 1945

Fort Shelby Hotel

9:30 a.m. Registration

10:00 a.m. Technical Meeting

"Humidity Measurement and Control in Steel and Allied Industries," by O. J. Leone, Regional Manager, Steel Mill Division, The Bristol Company, Pittsburgh, Pennsylvania.

"Blast Furnace Skip Hoists," by Gordon Fox, Vice-President, Freyn Engineering Company, Chicago, Illinois.

1:30 p.m. Technical Meeting

"A Modern Electric Furnace Installation," by Frank W. Brooke, Vice-President, and Henry K. Georgius, Swindell-Dressler Corporation, Pittsburgh, Pennsylvania.

"Applying Fluid Drive in Industry," by G. V. Edmonson, Staff Engineer, Hydraulic Coupling Division of American Blower Corporation, Detroit, Michigan.

"Modern Conveying Systems in Steel Plants," by L. L. Horchitz and Paul W. VanOrden, B. F. Goodrich Company, Akron, Ohio.

6:30 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. Elmer F. Weiss, Secretary
Detroit District Section
Association of Iron and Steel Engineers
2759 E. Grand Boulevard
Detroit, Michigan

Pittsburgh

September 26, 1945

Hotel William Penn

9:30 a.m. Registration

10:00 a.m. Technical Meeting

"Causes and Cures of Transient Voltages on Distribution Systems," by G. D. McCann, Transmission Engineer, Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania.

"Friction Sawing, Past and Present," by James M. Lewis, Consulting Engineer, Kling Bros. Engineering Works, Chicago, Illinois.

2:00 p.m. Technical Meeting

"Recent Developments in the Pyrometry of Liquid Iron and Steel," by H. T. Clark, Assistant Manager of Research and Development, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

"The Spraying of Gear Lubricants," by D. E. Whitehead, Chief Lubrication Engineer, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

"Carbon Products in the Steel Plant," by Frank Vosburgh, National Carbon Company, Inc., New York, New York.

6:00 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. Brent Wiley, Managing Director
Association of Iron and Steel Engineers
1010 Empire Building
Pittsburgh 22, Pennsylvania

Chicago

October 1. 1945

Del Prado Hotel

9:30 a.m. Registration

10:00 a.m. Technical Meeting

"Electric Drives for the Unitemper Mill — Their Selection and Operation," by J. D. Campbell, Steel Mill Division, Industrial Engineering Divisions, General Electric Company, Schenectady, New York, and J. G. McCurley, Electrical Engineer, Republic Steel Corporation, Warren, Ohio.

"Rail Mills and Rail Mill Roll Design," by Ross E. Beynon, Superintendent of Roll Shop Division, Carnegie-Illinois Steel Corporation, South Chicago, Illinois.

2:00 p.m. Technical Meeting

"Reclamation of Oils," by Jos. D. Lykins, Lubrication Engineer, Wheeling Steel Corporation, Yorkville, Ohio.

"Some Characteristics of Blast Furnace Gas," by Owen R. Rice, Metallurgical Engineer, Freyn Engineering Company, Chicago, Illinois.

"Development and Application of Twin Motor Drives," by G. E. Stoltz, Manager, Steel Mill Engineering Department, Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania.

6:00 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. A. J. Whitcomb, Secretary
Chicago District Section
Association of Iron and Steel Engineers
58 E. Washington Street
Chicago, Illinois

Cleveland

October 3, 1945

Hollenden Hotel

9:30 a.m. Registration

10:00 a.m. Technical Meeting

"Seamless Tube Piercing and the Problem of Making Steel Satisfactory for the Process," by Newell Hamilton, Superintendent — Steel Plant, The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania.

"The Manufacture of By-product Sulphuric Acid from Hydrogen Sulphide in Coke Oven Gas," by W. A. Leech, Jr., Koppers Company, Inc. and F. D. Schreiber, Pittsburgh Coke and Chemical Company, Pittsburgh, Pennsylvania.

2:00 p.m. Technical Meeting

"Conservation of Utilities in Republic's Canton Plant," by P. L. Walter, Superintendent Mechanical Department, Republic Steel Corporation, Canton, Ohio.

"Arc Furnace Switching," by L. W. Long, Engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, and J. C. Chipman, Engineer, Allis-Chalmers Manufacturing Company, Boston, Massachusetts.

"An Examination of Slow Cooling Methods," by J. William Barker, Staff Consultant, and Earl R. Cole, Engineer, Industrial Furnace Division, Loftus Engineering Corporation, Pittsburgh, Pennsylvania.

7:00 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. W. W. Spanagel, Secretary
Cleveland District Section
Association of Iron and Steel Engineers
16129 Euclid Avenue
Cleveland, Ohio

Philadelphia

October 6, 1945

Engineers' Society

9:30 a.m. Registration

10:00 a.m. Technical Meeting

"Thermit Welding in Steel Plant Maintenance," by J. H. Deppeler, Chief Engineer, Metal and Thermit Corporation, New York, New York.

"Rapid Heating of Steels with Gas Fuel to Heat Treating or Forging Temperatures," by Frederic O. Hess, President, Selas Corporation of America, Philadelphia, Pennsylvania.

2:00 p.m. Technical Meeting

"The Sendzimir Precision Cold Strip Mill," by T. Sendzimir, Vice-President, Armzen Company, Middletown, Ohio.

"Lighting Improvements and Developments for Steel Plants," by Davis H. Tuck, Professional Engineer — Electrical, Holophane Company, Inc., New York, New York.

"The Spraying of Gear Lubricants," by D. E. Whitehead, Chief Lubrication Engineer, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

6:00 p.m. Dinner

Reservations for dinner must be made in advance to:

Mr. Linn O. Morrow, Secretary
Philadelphia District Section
Association of Iron and Steel Engineers
Schaff Building
Philadelphia, Pennsylvania

PRESIDING OFFICERS *and* AUTHORS

J. L. Miller
F. H. Dyke
Alex Montgomery

L. R. Milburn
A. J. Fisher
R. E. Beynon

O. J. Leone
E. G. Fox
G. E. Stoltz

J. H. Deppele A. Le
H. T. Clark S. Loth
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E. R. Cole Sendz
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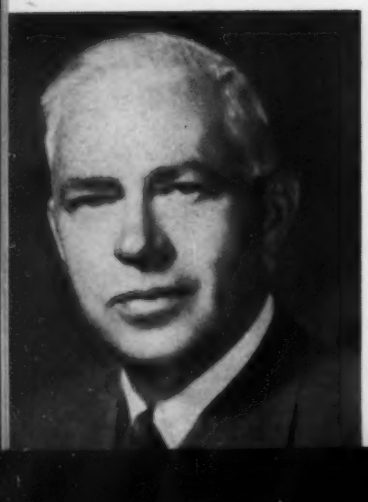
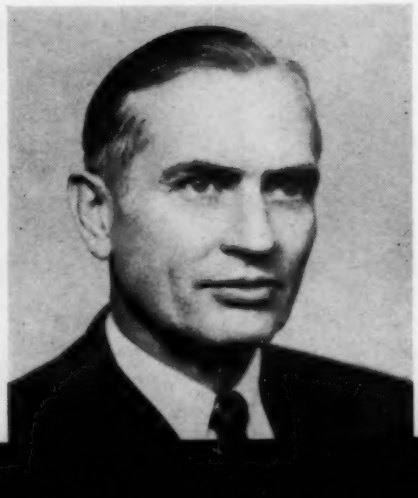

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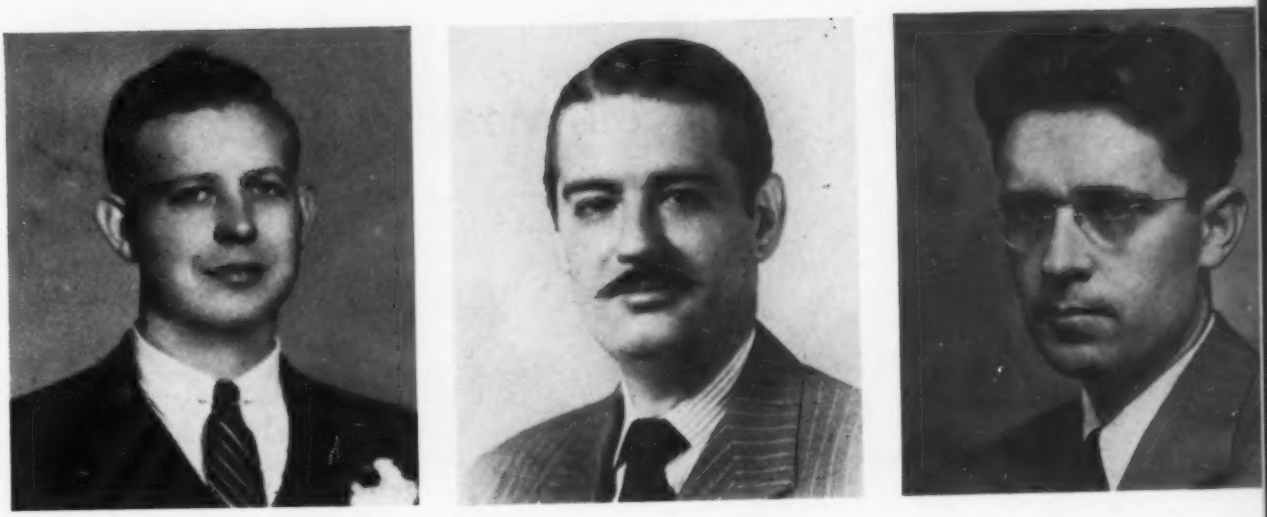

. Edmon D. Lykins
. Long E. Whitehead
. Van O D. McCann

Walter D. Schreiber
Cole Sendzimir
McCurle R. Rice

I. Tuck F. Chipman
. Lewis ee Horchitz
Campbel J. Vosburgh

Abstracts of Papers . . .

To be read at

A. I. S. E. Fall Meetings

RECENT DEVELOPMENTS IN THE PYROMETRY OF LIQUID IRON AND STEEL

By H. T. CLARK

Assistant Manager of Research and Development
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

One of the most important variables in the smelting of iron and refining of steel is the temperature of the liquid metal. It regulates to a major degree the reactions taking place in the furnace. It affects the life of the steelmaking equipment and the properties of the ingot. Thus it is one of the factors determining the cost of production and the quality of the steel.

In view of this, a number of investigators have developed methods of measuring liquid iron and steel temperatures in furnace, ladle or mold. Thermocouples of several types and various forms of radiation-measuring pyrometers have been used with varying degrees of success. The problem remains a difficult one due to (1) the high temperatures involved, (2) the reactive character of the furnace atmosphere, slag and metal, (3) the protective layer of slag usually present and (4) the high degree of accuracy required.

A survey of published information reveals certain inherent advantages and disadvantages to be associated with each method of measuring temperature. The thermocouples withstand the temperatures encountered but there are questions of calibration at these temperatures, contamination by furnace gases, and mechanical fragility, erosion and solution of protecting tubes. Radiation instruments, including optical pyrometers, are not subjected to extreme conditions and function satisfactorily for the measurement of high temperatures. They require however a direct view of the metal surface or of a second surface at the same temperature as the metal. Furthermore, the emissivity of the surface under observation must be known in order that an accurate correction can be applied to the temperature reading of the radiation pyrometer.

The quick-immersion technique with the platinum thermocouple and the open-end tube immersion pyrometer with photoelectric cells or total radiation pick-up units are recent developments which show considerable promise and are being put to practical use in steelmaking shops.

SEAMLESS TUBE PIERCING AND THE PROBLEM OF MAKING STEEL SATISFACTORY FOR THE PROCESS

By NEWELL HAMILTON

Superintendent—Steel Plant
The Babcock and Wilcox Tube Company
Beaver Falls, Pennsylvania

The development of the rotary piercing mill for the production of seamless tubes to its present important position in the metal working industry is reviewed and a brief description of the various types of mills is offered. The extremely drastic nature of the metal deformation in rotary piercing is discussed with relation to the properties of steel required for the process. Special emphasis is given to the problems of tube piercing brought about by the manufacture of seamless tubing from the stainless steels and other alloys with restricted hot working ranges. An attempt is made to define the properties of

good tube steel based upon extensive tube making experience.

Observations are made on the operation of a small electric furnace steel plant specifically designed for the production of alloy steels for seamless tube manufacture. The plant is described and the process control features of its operation are discussed.

BLAST FURNACE SKIP HOISTS

By GORDON FOX

Vice-President
Freyn Engineering Company
Chicago, Illinois

This is the third and concluding paper on this topic. In the preceding papers, which have been published in the Iron and Steel Engineer, the mechanical arrangement of the hoist engine was discussed, the advantages of the dual drive were mentioned and some new methods of control, for use with a constant-voltage supply and for use with adjustable-voltage supply, were described.

In the current paper the operation of charging the blast furnace is considered, with a view to indicating the relations between the filling method and the hoist performance. A graphic indication of the capacity rating of skip hoists is presented.

The matter of the running speed of skip hoists is considered, in relation to the trip time and the effect on power demand and motive equipment. The relation of the hoist movements to the charging cycle are surveyed and the fallacy of high running speeds for hoists is pointed out.

The merits and demerits of constant-voltage and adjustable-voltage supply for blast furnace skip hoists is discussed with a view to indicating the conditions which affect a choice.

AN EXAMINATION OF SLOW COOLING METHODS

By J. WILLIAM BARKER

Staff Consultant

and EARL R. COLE

Engineer, Industrial Furnace Division
Loftus Engineering Corporation
Pittsburgh, Pennsylvania

The basic reason for slow cooling it to prevent flake which can be defined as very tiny fissures in the body of the steel. In addition, slow cooling gives good results in machining and shearing qualities. There is no doubt as to the practical value of slow cooling, but there is much discussion on the efficiency of methods employed, but all methods which we have investigated have achieved the desired results.

The first slow cooling process consisted of burying the stock, whether billets or bars, in ashes, gravel, sand, and slag. This was not very satisfactory or dependable due to the stock being unevenly covered with the ends often protruding, thus allowing a great difference in the rate of cooling at various parts of the stock. This method was slow and expensive as it tied up cranes and required excessive labor in handling. The industry quickly recognized the necessity of improving upon this process and as a result installed various forms of cooling pits.

The first appeared to be steel slab lined holes or boxes and at one western Pennsylvania steel plant many examples of these are still being used, each being approximately 15 ft x 9 ft x 8 ft deep, lined with 3 in. steel slabs, backed by slag and gravel, 3 in. plates being used as covers.

At this plant, there are about 80 such boxes serving the blooming mill and they are usually charged with from 60 to 80 tons of blooms and billets each. All grades of 4 x 4 in. billets are slowly cooled for about 5 days.

The next step was the installation of brick lined pits with removable covers. One of the first installations of this type was at a Pittsburgh plant manufacturing mine appliances. This pit has been in service since early 1900, cooling cast wheels of 92 carbon for mine cars.

After the pit is charged with approximately 20 ton, the cover is placed on top and left for a period of 12 hours. After this period, the cover is removed for 24 hours, which permits the charge to cool rapidly to approximately 100 F. This process has given excellent uniformity.

The third step was cooling pits with auxiliary firing. A good example of this is found in a Western Pennsylvania plant. The furnace is 40 ft long, 8 ft 6 in. wide, 7 ft 8½ in. deep equipped with 13 top and 13 bottom gas burners.

This furnace designed for 60 to 90 tons of blooms or billets established control over critical slow cooling temperatures.

In all the foregoing cases the material handling is a real problem necessitating special equipment and therefore the tendency now appears to be the installation of car type furnaces.

RAIL MILLS AND RAIL MILL ROLL DESIGN

By ROSS E. BEYNON

Superintendent of Roll Shop Division
Carnegie-Illinois Steel Corporation
South Chicago, Illinois

The paper deals with rails and rail mills, and roll design for the production of rails. Historically, it shows some of the early rail mills, including one of 1835 as well as the Welsh Dowlias Mill of the 1860's. Some of the pioneer plants of this country are shown along with the development of the various mill types. The heavy rail mills of North America are discussed.

Rail development from the flat strap rail to the modern tee rail is illustrated, and the discussion of roll design shows the progress from early types to the modern designs. The paper contains more than fifty drawings illustrating the various mill layouts, roll passes, etc.

CAUSES AND CURES OF TRANSIENT VOLTAGES ON DISTRIBUTION SYSTEMS

By G. D. McCANN

Transmission Engineer
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

The various sources for transient overvoltages in distribution circuits will be discussed together with their characteristic wave shapes and their relative effects on equipment insulation. These include lightning surges, switching surges, and surges resulting from insulation failure. The most severe of this latter type are those which occur within solid insulation. The characteristics of surges occurring within rotating machine windings and the importance of protecting both line-to-ground and turn-to-turn insulation will be pointed out.

A discussion will be given on the effect of the distribution system impedances and layout on the character of these voltages.

Various protective methods will be described including lightning arresters and "de-ion" protector tubes used alone and in combination with capacitors and other impedance elements. Their effectiveness will be compared for the various types of disturbances with specific surge protection recommendations.

CONSERVATION OF UTILITIES IN REPUBLIC'S CANTON PLANT

By P. L. WALTER

Superintendent Mechanical Department
Republic Steel Corporation
Canton, Ohio

The term "utilities" as used and referred to in this paper is defined as "plant services or facilities" and includes electric energy, steam, water, air and gas in their various states and conditions of pressures, temperatures, voltages, etc.

The conservation of utilities in a steel plant is essential for two reasons: First because of cost considerations, since the cost of utilities is a considerable part of the cost per ton of product and this varies greatly depending upon the type and quality of the steel produced. Secondly, the comparatively limited supply of some of these utilities resulting from the limited facilities for their production or the materials from which they are produced requires that these services be used most conservatively.

Republic's Canton Plant because of its inland location and lack of any quantity of natural surface water supply is by necessity forced to utilize in every way possible its very limited water resources. For the most part this is accomplished by an ingenious recirculation and reclamation system which uses, reclaims and reuses the same water on applications which progressively require cooling waters of lesser quality so far as chemical and physical properties are concerned. The complete paper describes in detail the distribution system and how this small quantity of water meets the entire cooling water demand of this steel plant.

Not unlike water, the other utilities, steam, air and gas also require rigid conservation. In this plant, conservative use of these utilities is affected by maintaining steam main insulation, by the establishing of an inspection system for the control of leaks, by converting air and steam operated equipment to electrically driven units where ever possible, by maintaining as low pressures and temperatures as possible consistent with efficient operation of equipment, by accurate distribution metering, by rigid control of service connections and others presented in detail in the complete paper.

The maximum utilization of electric energy is obtained by the proper selection of equipment so as to secure the most economical operation of the individual applications, by maintaining demand control so as to utilize to a maximum extent the energy purchased and generated, by minimizing the losses in the distribution system and lowering purchased power costs with power factor correction, by the installation and maintenance of an efficient lighting system and by a properly designed, properly installed and well maintained distribution system.

With the prospect of reduced operations in the steel industry, the reconsideration of various procedures used in the economical utilization of utilities as outlined in this paper should be of interest to steel plant engineering and operating personnel.

RAPID HEATING OF STEELS WITH GAS FUEL TO HEAT TREATING OR FORGING TEMPERATURES

By FREDERIC O. HESS

President
Selas Corporation of America
Philadelphia, Pennsylvania

By completely combusting large amounts of gas in small burner volumes, and grouping many such burners in "patterned" banks closely surrounding the work — remarkable rates of heat transfer into steel have been achieved.

Primarily through the use of (a) precise and automatic carburetion of fuel and air, (b) delivery of carbureted fuel to burners under pressure, and (c) the extensive use of specialized ceramic components in burner design, surprisingly "condensed" combustion become feasible. In addition the geometry and "patterning" of burner groupings (in sleeves, tunnels, vertical panels, chamber roofs, and lines) has made the aforementioned high heat transfer rates adaptable to many important classes of work.

Short "hell-holes," only slightly larger than the work, continuously anneal, harden or draw rod, tube, bar and shapes — bringing heavy sections to heat treating temperatures at lineal speeds up to 40 fpm. "Opposed panels" of great numbers of radiant gas burners, in

banks, brighten electrodeposited tin plate, blue strip, and (in the future) may otherwise process strip on-the-fly. "Roofs" and "slots" studded with cup-type burners, bring large tube ends up to forging and swaging temperatures at full production rates but in small equipment. "Tunnels" of burners perform process anneals, brazes and other heat treatments on parts in unending single-file non-stop parade. "Open space patterns" of ceramic gas burners flame-harden, flame-anneal and braze at rates faster than heretofore. "Small bells" bring 6 in. billets up to forging conditions in 18 minutes.

It has been shown that metallurgical structures identical to those produced by conventional methods can be obtained through rapid heating to higher levels — that cracking can be avoided in high-speed heating — that the effects of time-at-heat (scale, decarb, etc.) can be minimized. Plant layouts and mechanics of flow of work through processes have been affected. New possibilities lie in devising new physical shapes of "burner envelopes" about work, further studies of heating speed in relation to heating uniformity, and finding yet-unencountered limits of heating speed without work damage.

ARC FURNACE SWITCHING

By L. W. LONG
Engineer
Allis-Chalmers Manufacturing Company
Milwaukee, Wisconsin
and J. F. CHIPMAN
Engineer
Allis-Chalmers Manufacturing Company
Boston, Massachusetts

The problem of providing adequate arc furnace switching is not a new one. The war effort has magnified the problem, and it is still with us and will continue to be with us in the postwar period when the competitive situation will definitely demand a complete solution.

Past performance of switching devices indicates that improvements in design and performances must come. The complete failure of some breakers and high maintenance costs on most breakers causing expensive shutdowns warrant extensive development and experimentation of suitable switching devices.

Several years ago it was advocated that the switching duty and short circuit protection of the furnace circuit be split into two devices. Considerable time and money were applied to this problem by both the electrical manufacturer and the operators. New air switches were developed, tested, built and now are in operation. One was designed for operation on 22 kv circuits and another for use on 15 kv and lower circuits. These devices are used as service switches to open and close the furnace circuit and are in series with a back-up breaker having proper interrupting capacity to interrupt any primary faults.

The paper to be presented will give details of construction of these two types of switches referred to. Their operating records to date will also be presented and comparisons made on cost of maintenance.

CARBON PRODUCTS IN THE STEEL PLANT

By FRANK VOSBURGH
National Carbon Company, Inc.
New York, New York

The use of carbon and graphite throughout the iron and steel industry has increased greatly in the past fifteen years and the many new applications are of interest.

Carbon linings for blast furnaces, long the standard material for that purpose in Europe, are now being given much thought in the United States and the several types are described and commented upon.

The applications of carbon brick to pickling tanks, blast furnace run-out troughs and runners are described and discussed. Cottrell precipitators for sulphuric acid concentration wholly built of carbon blocks are described.

The uses of carbon and graphite as mold plugs in ingot molds as well as for stools are discussed and recent results reported.

A new material, an impervious form of carbon or graphite, highly resistant to chemical attack and having unusual heat transfer qualities is being widely applied as heat exchangers for heating and cooling the most corrosive pickling solutions. The material is available also as pipe and fittings and is fabricated as valves and pumps.

Small graphite rods are being used in connection with blind, semi-blind and open risers to increase steel foundry efficiency and to produce better castings. Molds for ferrous and non-ferrous metals are now made from graphite in increasing quantities.

APPLYING FLUID DRIVE IN INDUSTRY

By G. V. EDMONSON
Staff Engineer, Hydraulic Coupling Division
American Blower Corporation
Detroit, Michigan

This paper deals with the two element hydro-kinetic type of fluid unit used for the transmission of power developed by electric motors and internal combustion engines. A brief description of three designs of fluid drive developed from the basic elements for marine, variable speed and traction duty is included. Typical performance curves and brief explanation serve to demonstrate the fundamental characteristics of fluid drive which form the basis for each application.

Power is required for every phase of operation of the iron and steel industry. The successful application of

power to the machine is necessary if the operation produces the desired results. The quality of the finished product depends in many cases upon the proper application of power. The paper describes several applications of power through fluid drive in the various phases of the industry from the mining of iron ore to the finished product.

New processes have been developed to fabricate fluid drives to meet the requirements of war production. Both the application of fluid drive and the processes are described briefly.

LIGHTING IMPROVEMENTS AND DEVELOPMENTS FOR STEEL PLANTS

By DAVIS H. TUCK

Professional Engineer—Electrical
Holophane Company, Inc.
New York, New York

We have been deluged by articles from the pens of imagineers who would have us believe that in the utopian postwar era, electronics and plastics will solve all of our troubles, including our social ones — plastics will replace steel, and electronics will take care of everything else. These same imagineers have shown designs of postwar farm tractors with enclosed cabs, windshields, and fenders, and have told us about postwar commercial aviation — how huge passenger planes from all over the world will be landing in New York on schedule, guided down to the airport in any weather by electronics.

Just about the same conditions exist in the lighting business. We hear about postwar plans, and when all is said and done, they are about the same as before the war. In the lighting business there have been no revolutionary advances made. Lamps are essentially the same as before the war. Incandescent, mercury, and fluorescent lighting units are the same as before the war with some new types of special application.

Improvements in lighting are mainly in application and mechanical advantages. Studies have been made which have integrated all that we know about light and seeing, so that personal likes and dislikes, prejudice, the effects of super salesmanship, reciprocity buying, and false advertising will be side-tracked, and facts shown by an intelligent analysis of the problem will govern the decisions.

This review naturally divides into two parts:

I — A discussion of those fundamental concepts which have resulted in new engineering thinking.

II — A discussion of specific improvements that have been made in equipment as a result of experience gained during the war.

Part I includes a discussion of in-service factors, economic analysis of a lighting system, the logical application of incandescent, mercury and fluorescent lamps.

Part II describes new specific equipment and mechanical improvements to the existing equipment of the various manufacturers that will increase efficiency and reduce maintenance.

MODERN CONVEYING SYSTEMS IN STEEL PLANTS

By L. L. HORCHITZ
and PAUL W. VAN ORDEN

B. F. Goodrich Company
Akron, Ohio

General use of belt conveyors to handle raw materials has been accomplished at both the Geneva Steel Corporation and the Fontana plant of Kaiser Company, Inc. At Geneva all major raw materials except the scrap and limestone flow through the plant on conveyors; at Fontana everything is carried on belts. The design, operation and maintenance of these systems suggest possible application at other plants.

Of particular interest is a unique cooling device in the Fontana sintering plant, where a 46 ft diameter turntable allows the hot sinter to cool down to 150 F before reaching the belt. This eliminates uncertain or uneven cooling which may result from spraying, and greatly prolongs the life of the "hot material" belts.

Use of cushioning idlers and double tapered skirt board design is effective in increasing belt life. The adoption of proper skirt board material and avoiding the false economy of trying to use up pieces of scrap conveyor belt are other factors noted in belt conservation.

Following the now common practice in major construction operations and the outstanding conveyor systems of the Frick Coal Company, we find the mine belts in Utah and all raw materials belts at Fontana using vulcanized splices and eliminating fasteners. The strength of the belt joints is thus approximately doubled and the most common cause of belt troubles is eliminated.

In conjunction with splicing, Fontana operates a belt maintenance program which allows them to make permanent vulcanized repairs. This avoids the hazard of minor cuts or damage resulting in major failures and ruining entire belts as well as causing shutdowns and production loss.

Use of cord construction belts rather than fabric is found general on all the tougher jobs at Fontana. This reflects recent trends in ore handling on the Mesabi range and lake docks, as well as in coal handling in mines converting to mechanical mining and belt conveyors.

RECLAMATION OF OILS

By JOS. D. LYKINS

Lubrication Engineer
Wheeling Steel Corporation
Yorkville, Ohio

The proposed paper will discuss the various causes of oil breakdown, including the agencies affecting lubricating oils in service, their products, the results of oil

contamination and the different methods of preventing and removing contamination from the oils.

There are several methods for removing this contamination. These include screen type strainers or filters, pressure or vacuum filters, magnetic filters, gravity purifiers, distillation, centrifuge and contact earth or adsorbent materials. These various methods will be discussed as to what impurities each will remove and the impurities they will not remove.

The operation of the lubricating and palm oil recovery units at one of the Wheeling Steel Corporation plants will be explained. Also the results of tests run on the new, used and reclaimed oils thereby showing the effectiveness of the recovery equipment.

THE MANUFACTURE OF BY-PRODUCT SULPHURIC ACID FROM HYDROGEN SULPHIDE IN COKE OVEN GAS

By W. A. LEECH, JR.

Koppers Company, Inc.

and F. D. SCHREIBER

Pittsburgh Coke and Chemical Company

Pittsburgh, Pennsylvania

Since the introduction of gas lighting as a result of Murdock's work in 1802 and the initial purification of coal gas by Clegg in 1809 by absorption of hydrogen sulphide in a milk of lime solution, there has been continuous progress in the methods of sulphur removal from coal gas.

Recently the attention of the byproduct coke-oven industry has been particularly directed to various means of recovering this sulphur for use. It fits naturally into the flow sheet best as sulphuric acid which may be used in turn in the production of ammonium sulphate. A combination of practical processes is now in use by means of which 90 per cent of the hydrogen sulphide is removed from the oven gas and converted into sulphuric acid. Consumption of power and chemicals is low and the plant equipment is satisfactory.

Removal of hydrogen sulphide from the coke-oven gas is accomplished by the hot-actification sulphur-recovery process. In this process the gas is scrubbed with a dilute solution of sodium carbonate. The foul solution is regenerated by steam distillation in a tower packed with steel-spiral packing and operating under a vacuum provided by a reciprocating vacuum pump which pulls the gases through the cooling and condensing equipment and supplies them under pressure to the acid plant. The heat for the steam distillation may be obtained by heat exchange from the hot flushing-liquor on its way back to the sprays in the ascension pipes and collecting main of the coke-oven battery. In coke-oven plants using tar flushing, the heat may be obtained by heat exchange from the coke-oven gas between the collecting main and the primary cooler. In either case free heat is furnished for the actification and the heat load on the primary cooler is reduced.

Hydrogen cyanide is also removed from the coke-oven gas by the sodium carbonate solution and it is recovered mixed with the hydrogen sulphide at the outlet of the actifier tower. It is necessary, on account of the deleterious effect of hydrogen cyanide in forming nitrogen compounds, to remove the hydrogen cyanide from the hydrogen sulphide before it is burned in a contact sulphuric acid plant. This is done by a simple water wash in a small packed absorber. The small concentrations of hydrogen sulphide and carbon dioxide are stripped from the wash water by a still and returned to the main hydrogen sulphide stream. The hydrogen cyanide remains in the wash water and is recovered from it by a second distillation. The hydrogen cyanide in turn is absorbed in a solution of sodium hydroxide in a packed tower, producing a 30 per cent solution of sodium cyanide which is sold as such.

The hydrogen sulphide is burned in a simple gas burner in the sulphur furnace of the contact sulphuric acid plant for production of sulphuric acid. Some changes in the acid plant are made to remove the water formed by combustion of the hydrogen in the hydrogen sulphide and to recover the heat from the combustion of the hydrogen. The catalyst life has been considerably onger on one installation burning hydrogen sulphide han on a secon l unit burning sulphur in the same plant.

ELECTRIC DRIVES FOR THE UNITEMPER MILL —THEIR SELECTION AND OPERATION

By J. D. CAMPBELL

Steel Mill Division, Industrial Engineering Divisions
General Electric Company
Schenectady, New York

and J. C. McCURLEY

Electrical Engineer
Republic Steel Corporation
Warren, Ohio

Usually, strip steel is temper-rolled or skin-passed in conventional two-high or four-high rolling mills, each consisting of a single stand or two stands in tandem. Cold working, by rolling, has been the principle means of obtaining the desired temper, while strip tension values are practically a secondary consideration.

On the other hand, the Unitemper mill operates upon a different principle, whereby the desired temper is obtained by the continuous stretching of the material. Here the rolling action of the mill rolls takes place to only a minor degree. Because of these fundamental differences between the conventional temper mill and the Unitemper mill, their mechanical and electrical arrangements differ in several respects.

In this paper some of the unusual constructions of the electric equipment and the arrangement and operation of the Unitemper mill drives will be discussed. Since the stretching of the material produces the temper to a large extent, it is important that the amount of stretch be accurately controlled. The success of the Unitemper mill is due in a large degree to the ability of the electric motors and control to hold this elongation or stretching within very close limits. Also, the amount of elongation must be easily adjustable for various degrees of temper; but at a given setting of elongation, that value of elongation must be closely held.

The electric equipment on the Unitemper mill and the conventional temper mill will be compared. The differences in the method of locating the motor drives will be pointed out.

Based on three years operating experience on the Unitemper mill, at delivery speeds as high as 3000 fpm, it appears that speeds far above this are now practical considerations.

FRICTION SAWING, PAST AND PRESENT

By JAMES M. LEWIS

Consulting Engineer

Kling Bros. Engineering Works

Chicago, Illinois

Friction sawing is one of few mechanical processes which employ the heat of friction in a useful manner. It concentrates heat on the material to be severed at a rate which is faster than it can absorb heat. The immediate temperature rise of the contact surface is so great that its strength is reduced considerably below that of the colder blade rim. This heated surface is readily removed by the blade and permits complete severing of the material rapidly with no loss of metal from the blade.

Many engineers, designers and users of machines have been trained to consider friction as a destructive force which is to be avoided wherever possible with the result that they have become "anti-friction" minded. This condition may partially account for the present lack of reference data on the subject of friction sawing in our text-books and engineering hand-books.

However, there are on record some articles about the use of friction sawing dating back as far as 1823, and this article is intended as a review of the past published record as well as a record of later applications of friction sawing, together with a further explanation of the process.

In 1824, Messrs. Darier and Colladon conducted experiments at Geneva, Switzerland, with a 7½ in. soft iron plate and found the critical speed to be between 34 ft 5 in. and 34 ft 9 in. per second. At higher speeds up to 70 fps the disc was only slightly attacked, and at speeds above 70 fps the disc was unaffected. For some reason these men rejected the heat theory and assumed that high heat was not necessary to the severing action but merely incidental.

Let us consider a modern friction saw as used by an American railroad for reclaiming railroad rail ranging from 80 to 130 lb and equipped with 48 in. diameter by $\frac{9}{32}$ in. thick smooth rim blade directly driven by a 75 hp, 1750 rpm motor with a constant pressure feed system for advancing the blade through the rail. The rails are conveyed by power rolls one at a time to position for cutting on the saw table so that the portion which has been damaged in service by contact with the angle bars will be severed from each end of the rail requiring two separate cuts per rail together with the handling time of moving the rail to position. The total cycle time per rail is one minute, or 60 rails per hr.

The average size rail is 90 lb and the cutting time alone is 13.8 sec per cut with full load of 75 hp on the driving motor. Because of the idling time between cuts the motor is operated at a higher load than full load. With a load of 97.5 hp or 130 per cent of rated capacity the time is 10.6 sec per cut. The saw blade is redressed during the noon hour and operates through four hours in the afternoon and another four hours the next morning. With two cuts per minute, the blade makes 960 cuts per blade dressing. At the end of each run the blade is rough on the rim and only slightly deformed and is readily redressed by a lathe tool moved across the face of the rim when rotating at slow speed.

The same blade is kept in service until eventually too small after about 70 redressings or 67,000 cuts on rail averaging 8.83 sq in. per cut, or about 593,000 sq in.

This production is typical of modern friction sawing where heat of friction is usefully employed for severing high carbon steel rail with long blade life made possible by properly dissipating heat from the blade for the entire duration of each cut. Friction sawing has certain limitations because of its effect on the sawed surfaces of the severed material and these are fully explained.

HUMIDITY MEASUREMENT AND CONTROL IN STEEL AND ALLIED INDUSTRIES

By O. J. LEONE

Regional Manager, Steel Mill Division

The Bristol Company

Pittsburgh, Pennsylvania

In recent years increasing interest has been shown by engineers in the measurement and control of the water vapor which enters into iron and steel making processes. The development of newer and modern air conditioning equipment as well as demands for increased and more uniform production, more rigid control specifications, and the desire to reduce production costs, have encouraged the improvement of old applications and the development of new methods.

The development on many applications, however, has lagged considerably for the want of suitable humidity measuring devices. As compared with other measuring instruments, available humidity instruments have been either difficult to operate or limited in application.

In many instances it would be desirable to automatically and directly record or control dew point, relative or percentage humidity, or absolute humidity. While special instruments have been developed to directly measure such values as dew point or relative humidity they have not been adaptable to many applications in the steel industry. A main reason is that the operating conditions encountered are probably more difficult than in other industries. When used in steel and allied industries such instruments are often required to operate in dusty atmospheres which may contain complex mixtures of gases; on other applications they must operate in closed pipe systems under wide ranges of variable pressures and dry bulb temperatures. The space may be a closed vessel so that removal of enough sample volume to permit a flow over the measuring device is not practical; in other cases where low humidity must be maintained one cannot use a wet bulb method.

The purpose of this paper will be to review several of the common applications, to describe the various measuring methods used, and their advantages or limitations. The following processes will be discussed:

1. Humidity control on blast furnaces and cupolas. Both dry blast and moisture control will be discussed. Several methods of directly recording and controlling absolute humidity under variable pressure and temperature conditions are covered.
2. Dew point measurement for special atmospheres, as in the maintenance of equilibrium ratios of H_2O/H_2 to prevent decarburization on surface oxidation or discolorization on steel. The various measuring methods will be covered, together with their advantages or limitations.
3. Measurement of humidity in warehouses and humidity problems encountered in the shipment of steel products from the northern to southern climates. Special problems in water shipments by barge are mentioned.
4. Humidity measurement and control in drying steel plant refractories. Under this subject the latest drying methods for bricks, hot tops, retorts and pouring nozzles and sleeves are discussed.
5. Miscellaneous applications — humidity control on baking enameling or varnish drying ovens, core ovens, motor rooms, and humidity control on fuel systems are covered.

THERMIT WELDING IN STEEL PLANT MAINTENANCE

By J. H. DEPPELER

Chief Engineer

Metal and Thermit Corporation

New York, New York

The paper describes first the process by which superheated steel is generated by reaction of the cold mass and a mixture of iron oxide and aluminum, with alloying elements, which in thirty seconds generates a molten steel of any required analysis and with 100 per cent superheat, that is, a temperature of over 5000 F. This steel is used for welding the heavy sections in the repair work in a steel mill and also in the fabrication of new parts, which are superior to parts made in any other way, having the desirable toughness in the main body with the necessary hardness and wear resistance in the wabbler ends.

The author then goes on to cite numerous actual examples wherein thermit is used in the steel mill and shows the savings made possible.

Cases are cited of the fabrication of a blooming mill pinion housing weighing 22,500 lb; another of the fabrication of a huge drop platform freight car, 90 ft long, built for the Carnegie-Illinois Steel Company by the Greenville Steel Car Company; and a third, the construction of bend rolls 38 ft long and 31½ in. in diameter by thermit welding at their mid-length.

Many other cases of actual repairs are given, in some of which wax is used as a pattern, and in others, wooden patterns and plaster-of-paris.

The method of replacing a broken tooth in a pinion is described in detail, in which a slot is cut at the base of the broken tooth in order to provide more surface for fusion, and in addition to this, the entire pinion is heated.

The lecture is accompanied by lantern slides which show the tables used, by which an operator can decide on the dimensions of the gap, the size of all the gates and risers, and the amounts of thermit to be used.

The thermit steel, although cast, is unlike ordinary cast steel because of the extreme purity of the iron oxide and aluminum used, thus making the fracture through the grain of the steel instead of along grain boundaries. Cases are mentioned to show that this thermit steel is equal in every way to forged steel and must not, therefore, be likened to ordinary cast steel.

A MODERN ELECTRIC FURNACE INSTALLATION

By FRANK W. BROOKE

Vice-President

Swindell-Dressler Corporation

Pittsburgh, Pennsylvania

As part of the naval expansion program, a new steel plant was installed in 1943 at Homestead, Pennsylvania under the direction of the Mesta Machine Company. This plant consisted of a melting and forging shop and a large machine shop for finishing heavy forgings. This paper will describe the melting unit.

The melting unit was built around two 17 ft diameter, top-charge, electric arc melting furnaces. One of its outstanding features is the straight line travel of all material from the scrap bins to the finished forgings.

Next in line are the heating furnaces which bring the ingots up to forging temperature. These are followed by the hydraulic forging presses. The far end of the building forms a storage for finished forgings.

The building design provides for ample floor space and overhead crane clearance. These, together with a large window area, provide good working conditions and the possibility for future additions to the equipment.

The two electric melting furnaces are unique in several respects. One of these is that the furnace shells are one-piece steel castings with an inside diameter of 17 ft. Cast integral with the shell is a water jacket which completely surrounds it and extends from the roof line to the sill level. In order to minimize the water consumption on furnaces so liberally provided with water as these, a system for re-using the water was especially developed.

Each furnace is powered by means of a 10,000 kva transformer of special arc furnace design. These transformers include an unusual feature by means of which considerable amounts of critical materials were saved in their construction. Each transformer is provided with taps by means of which ten secondary voltages are made available.

Each furnace is provided with an air circuit breaker, especially designed for arc furnace service. This is of great importance in any arc furnace installation, since the mechanical feature of the breaker are of at least as great importance as its electrical features.

The electrodes are controlled by means of rotary variable voltage regulators, which provide smoother control, thereby decreasing the wear and tear on the electrode mechanism and improving melting conditions.

DEVELOPMENT AND APPLICATION OF TWIN MOTOR DRIVES

By G. E. STOLTZ

Manager, Steel Mill Engineering Department

Westinghouse Electric Corporation

East Pittsburgh, Pennsylvania

The first installation of main roll twin motor drives was made on a 54 in. blooming mill and a 45 in. slabbing mill at the South Chicago plant of the Carnegie-Illinois Steel Corporation in 1930. Since that date, practically all large slabbing mills installed in this country have used twin motor drives. The reason for this has been to avoid building gears for the high motor torques required on such mill.

During the war period, a 10,000 hp, 40-80 rpm reversing twin motor was installed on a large plate mill. This drive has been very satisfactory and gives promise of extending the application of this method of drive. Continuous sheet and tin mills are now being designed with twin motor drives for the finishing stands.

On the blooming mill and slabbing mills, the spindles are operated at an angle to permit direct coupling of the driving motors to the rolls, but on the sheet and tin mills the speeds are much higher and offsetting gears are used so that the driving spindles can parallel the center line of the rolls.

Four-high temper pass mills are also being designed for twin drive on the main work rolls. On this mill the diameter of the motor frames is sufficiently small to direct connect them to the working rolls.

Still another application of twin motor drive is tube forming rolls where the pitch of the top and bottom roll may differ with the possibility of having different pitch diameters. In such an application, the twin motors adjust their speed to accommodate the particular pitch diameter that prevails when rolling any particular product.

This paper will give a detailed story of the development and application of twin motor drives for these various types of mills.

SOME CHARACTERISTICS OF BLAST FURNACE GAS

By OWEN R. RICE

Metallurgical Engineer

Freyn Engineering Company

Chicago, Illinois

Fundamental relationships of gas quantity per unit of blast blown, and gas quantity per unit of coke charged, are explained and tabulated, and the grades of blast furnace gas as resulting from coke rates per ton of pig, are presented graphically.

Typical blast furnace gas is presented in three categories: "Lean," 87 Btu; "Medium," 92 Btu; and "Rich," 98 Btu. These classifications are derived from a study of average annual coke rates at pig iron, coke-fired blast furnaces throughout the country over the last thirty-one years, but more particularly from a sampling of coke rates at many individual furnaces in current years. Actual blast furnace gas is that which the user receives, rather than that which the analyzer reports. Corrections may be required.

Combustion criteria of blast furnace gas of the three typical grades, under a variety of actual conditions, are tabulated and depicted graphically. A hypothetical heat balance on a hot blast stove is presented, showing that it is not difficult to slip into erroneous conclusions.

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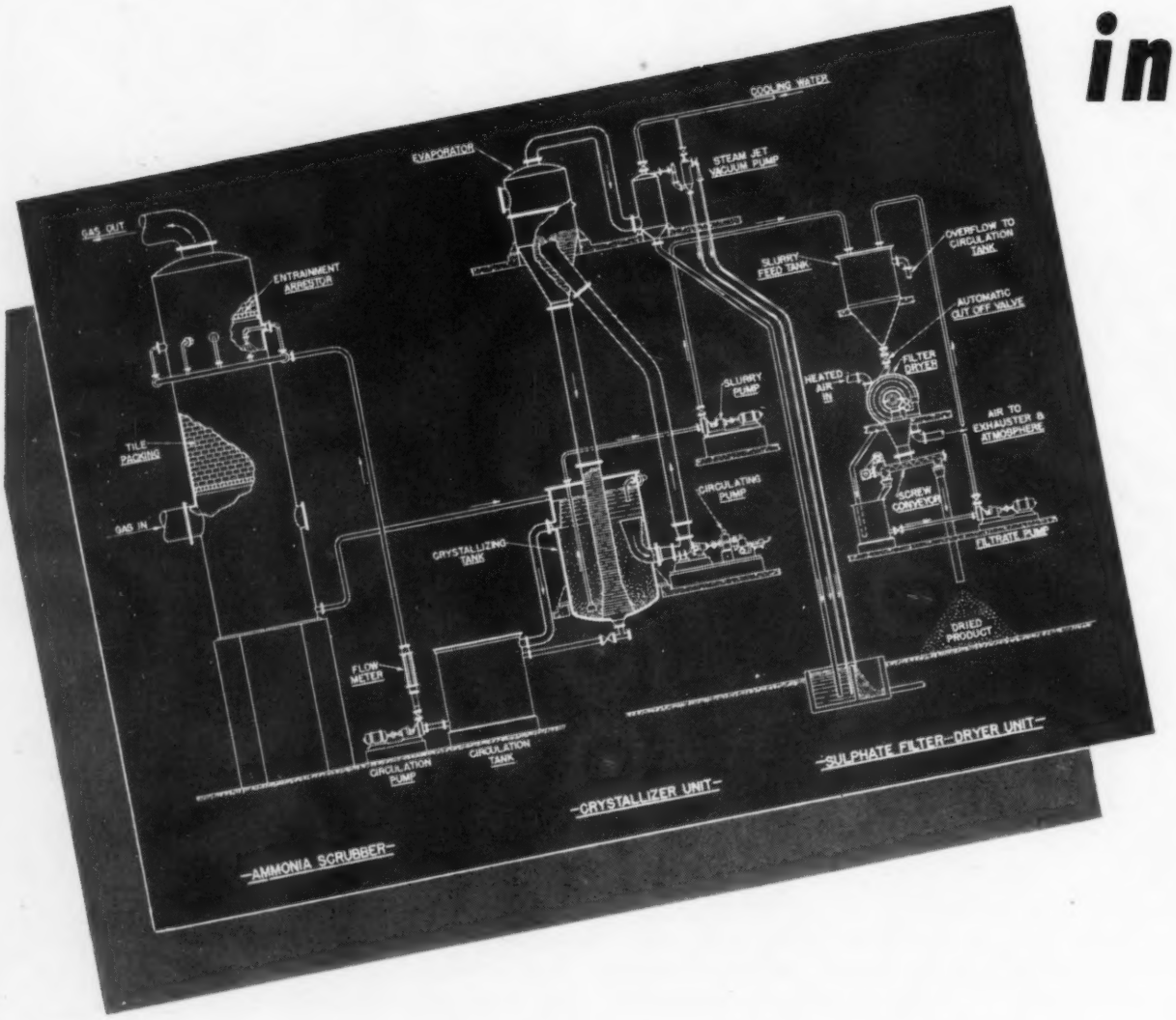

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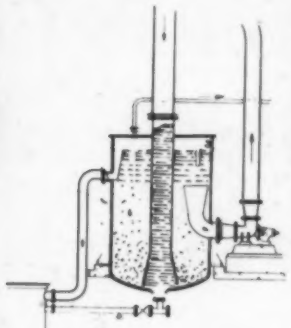

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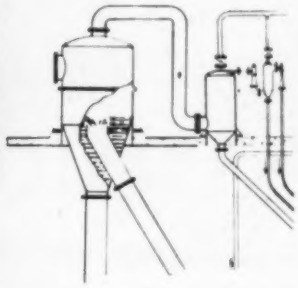
CONCENTRATION

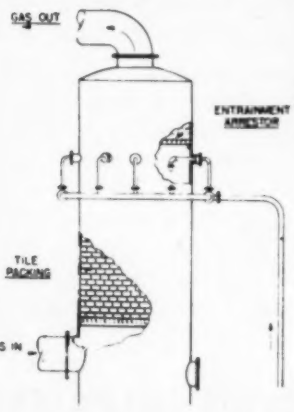
OF SOLUTION IN THE VAPORIZER

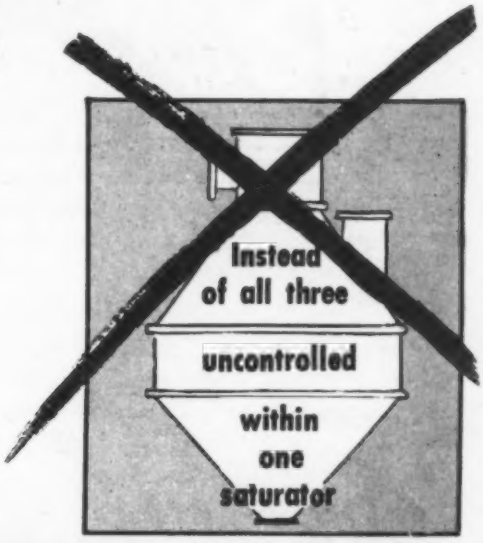


1

ABSORPTION

OF AMMONIA IN THE PROCESS





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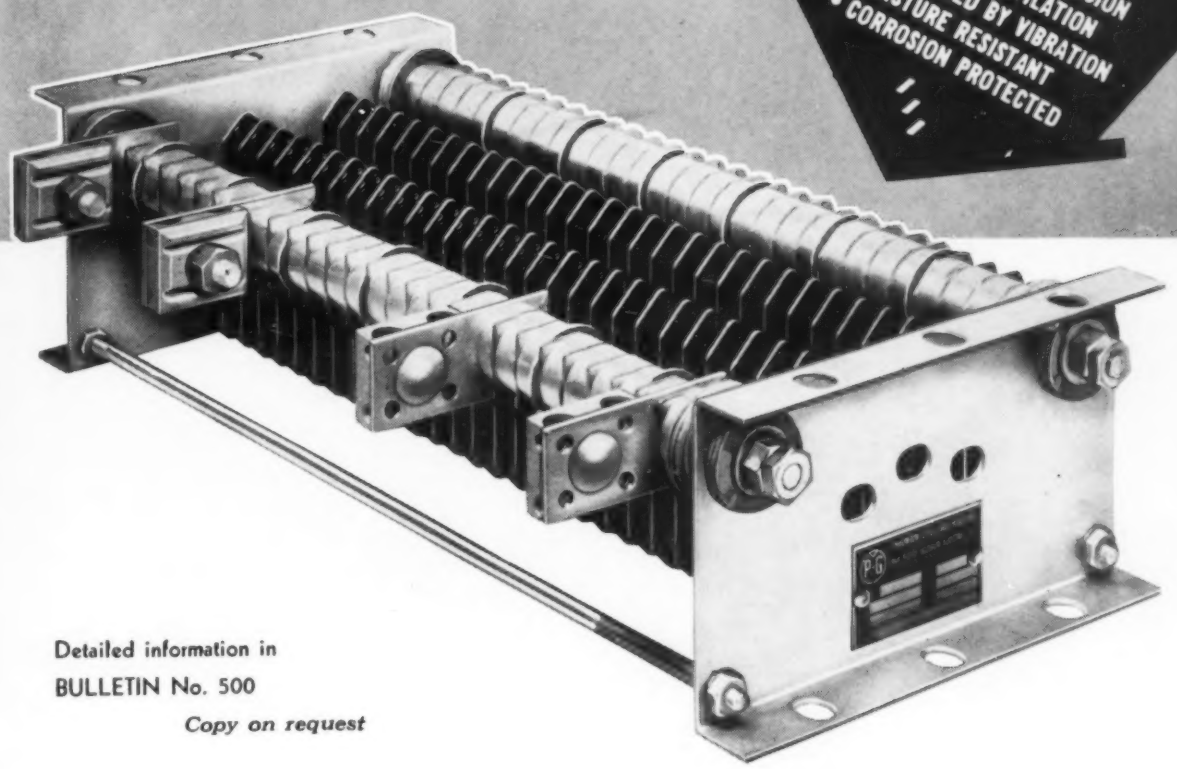

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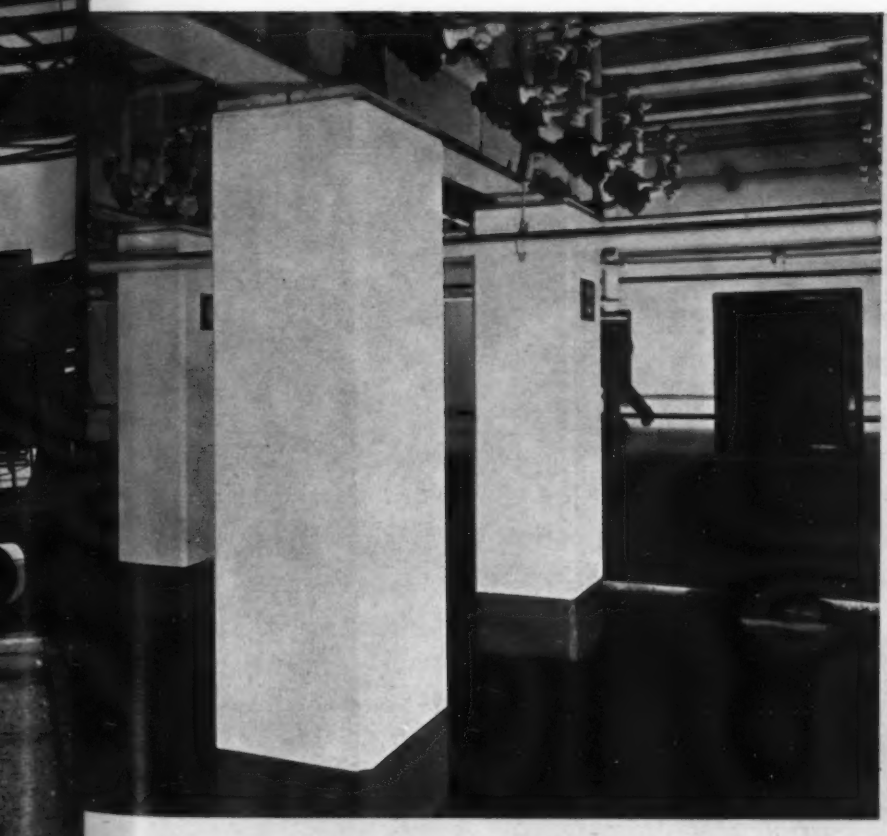

Looking across the basement — view showing the oven fuel-gas distributing main, the gas-reversing cocks and the gas manifolds.

Longitudinal basement view showing concrete foundation columns, a fuel-gas manifold and connections to the underjets.

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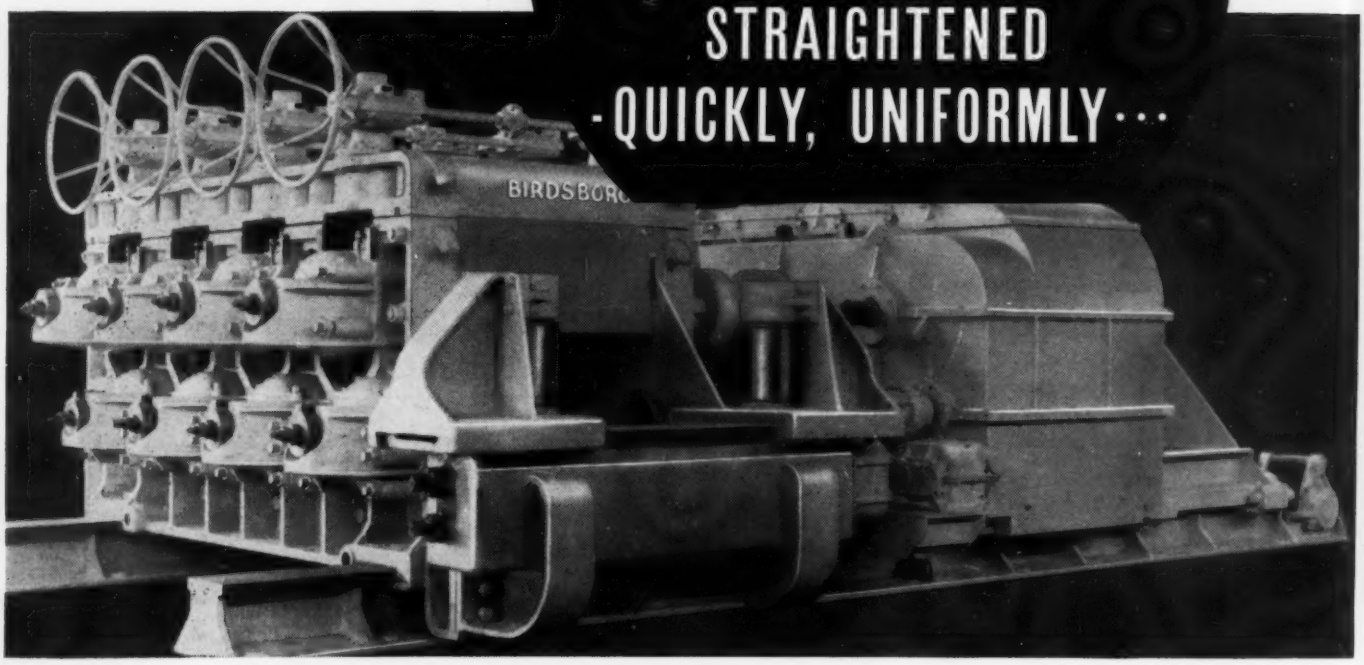

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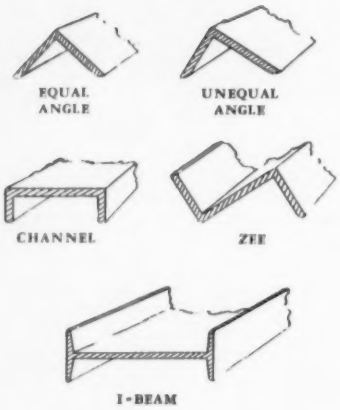

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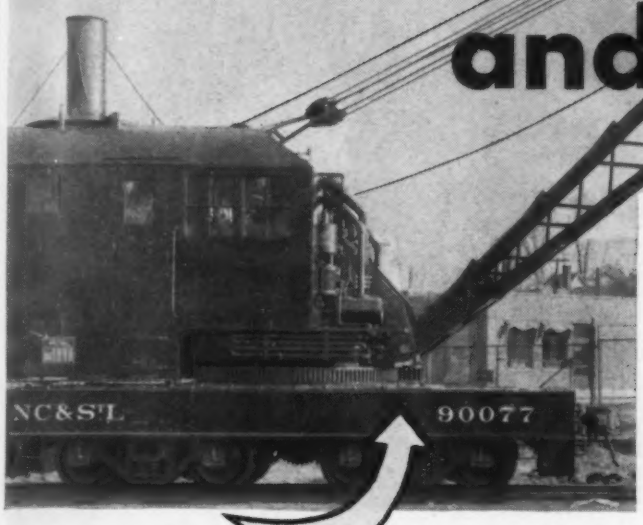
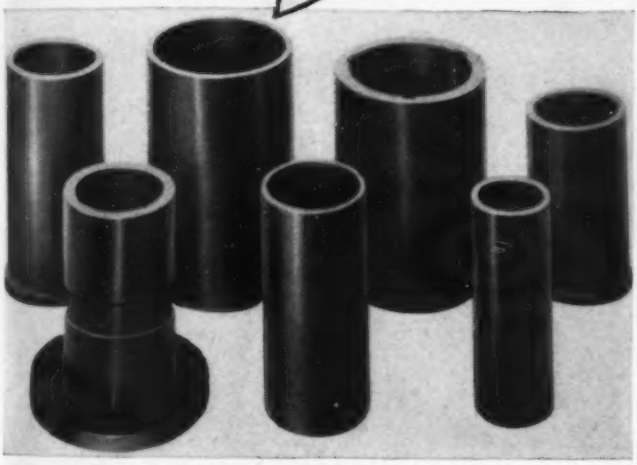




Forty-six GATKE Bearings have outworn 276 Bronze Bushings and are still giving excellent service.

More than three years ago the 46 GATKE Bearings were used to replace Bronze Bushings in overhauling a Locomotive Crane, which has been operating 24 hours a day, seven days a week, moving iron ore. A recent inspection showed the GATKE Bearings in good condition—not one required replacement after three years of service.

The operating crew states that before installing GATKE Bearings they never got more than 6 months' service between overhauls and that usually a crane had to be "shopped" for repairs after a much shorter period.

The installation involved the most difficult and critical applications on the Crane—the results suggest the wonderful advantages offered by GATKE Bearings for all sorts of applications.

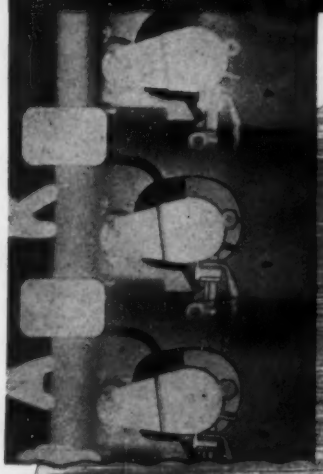
Whatever the requirements, however difficult or unusual, send details of the application for the GATKE Recommendation.

One critical application of GATKE Bearings is on the Turn Table Rolls where the bearings are subjected to terrific shocks and slow speed rubbing under crushing pressures as the crane picks up and swings heavy loads on a long boom. No wonder conventional bearings wear rapidly, gall, and score journals on such applications.

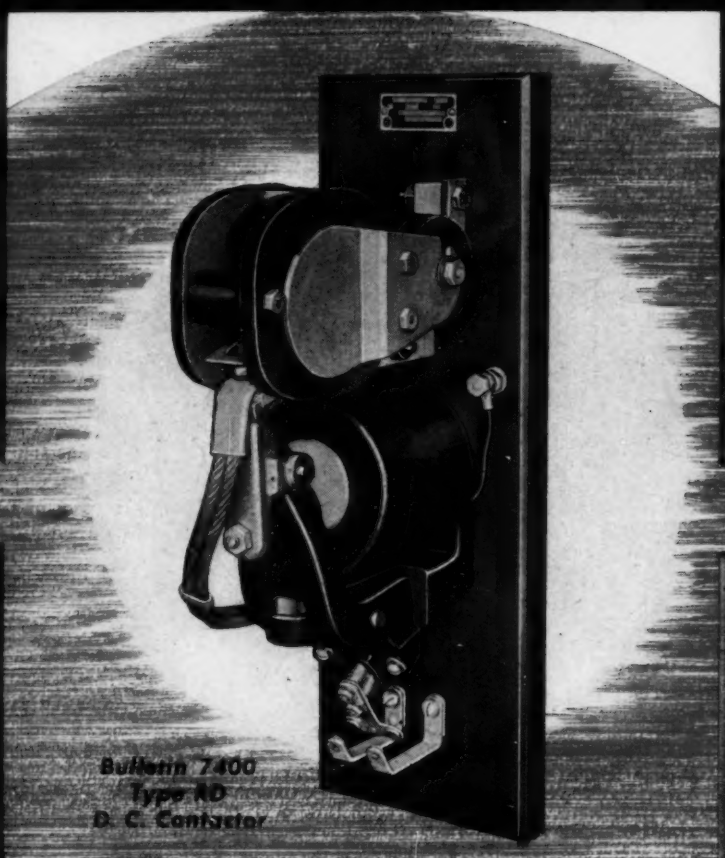
GATKE Bearings were originated for jobs like this. They withstand terrific impact loads—do not score—have low friction and tremendous wear life. New 68 page brochure tells why. Write for your copy.

GATKE
CORPORATION
228 N. La Salle St., Chicago 1, Ill.

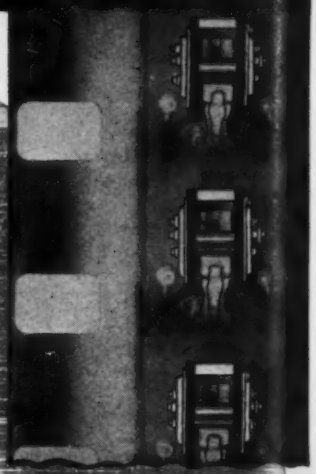
IT'S NO SECRET! BUT STILL A REAL WEAPON FOR REDUCING YOUR MAINTENANCE



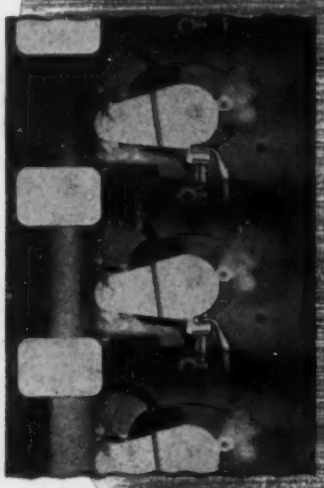
Side View—CONTACTS FULLY CLOSED



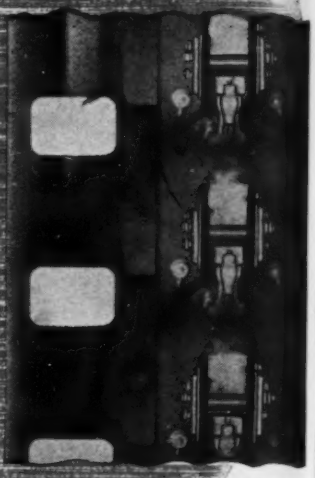
Bulletin 7400
Type BD
D. C. Contactor



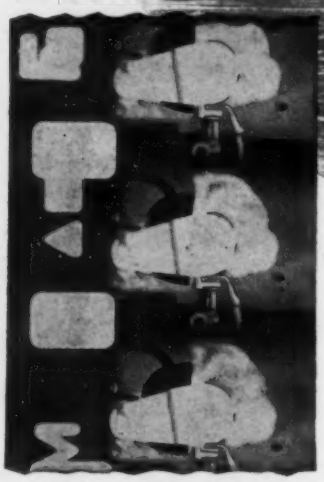
Front View—CONTACTS FULLY CLOSED



Side View—CONTACTS OPEN, START OF ARC



Front View—CONTACTS OPEN, START OF ARC



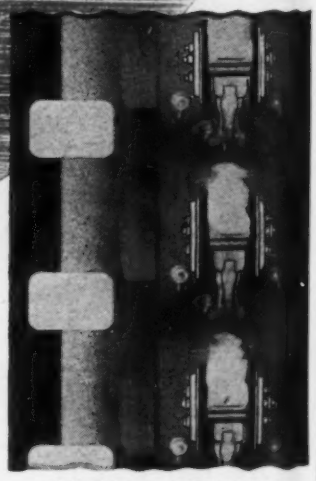
Front View—CONTACTS OPEN, ARC AT MAXIMUM

The better Electrical Control apparatus is built, the lower your maintenance costs. To "build-in" low maintenance is always a "3C" goal. That's why The Clark Controller Company uses a high speed motion picture camera.

It's an effective weapon to study performance. Faults can be detected and good design observed which standard methods of testing cannot record.

3,000 pictures a minute—(small sections shown to right and left)—record the operation of a "3C" bulletin 7400 BD D. C. Contactor. Projected at regular speed, these films show in very slow motion many standard operating characteristics which cannot be seen directly. This makes visual otherwise unavailable data. Note particularly how the arc is controlled.

The use of this camera and many other modern methods is visual evidence of Clark Controller Company progressiveness and care in "building-in" qualities that add dependability and reduce maintenance costs on all "3C" equipment.



Side View—CONTACTS OPEN, ARC AT MAXIMUM

THE CLARK CONTROLLER CO.

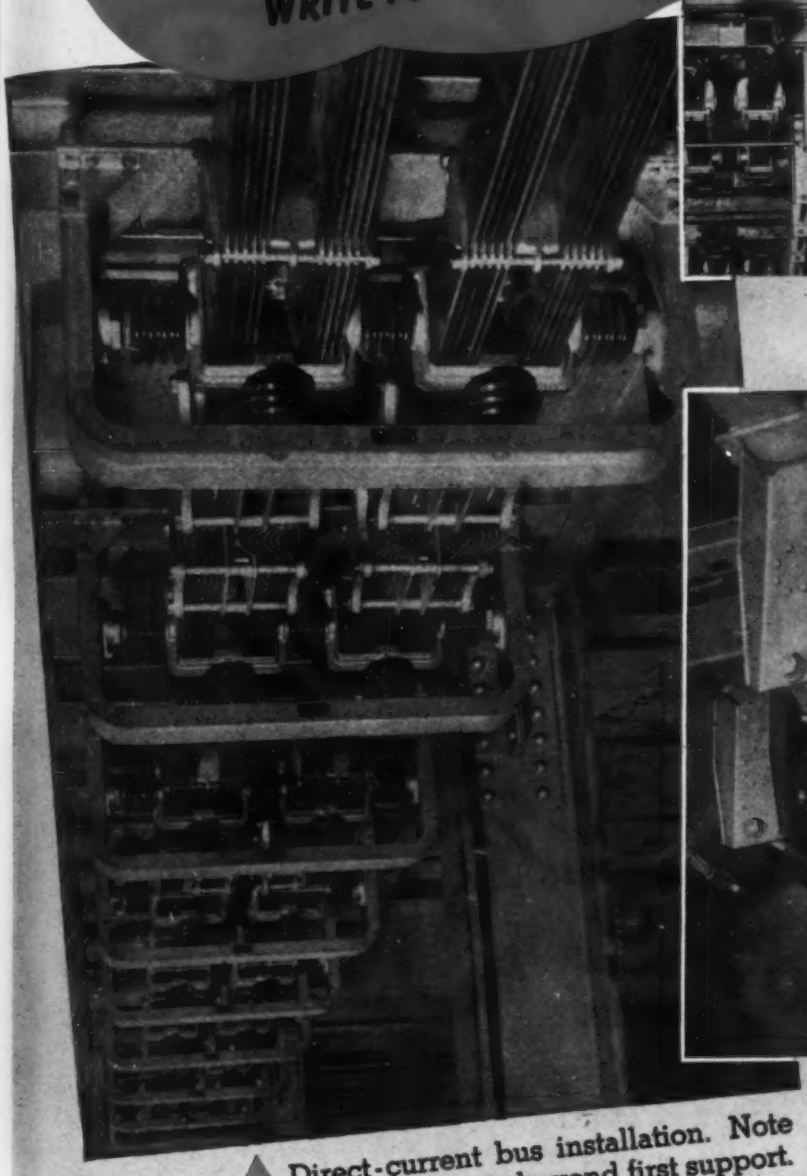
1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

SAVE TIME—LOWER COSTS

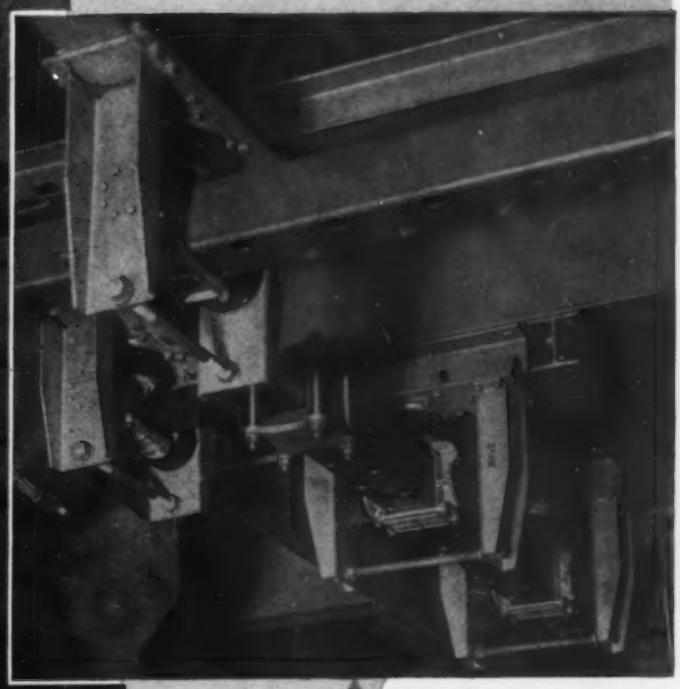
BY USING DELTA-STAR REINFORCED BUS STRUCTURES—BUILT TO ORDER FOR HEAVY DUTY STEEL MILL SERVICE

WRITE FOR PUBLICATION 4504

▲ Ventilated square tube bus installation in a midwestern steel mill.



▲ Direct-current bus installation. Note expansion joints beyond first support.



▲ Square tube support with flat bar tap.

DELTA-STAR ELECTRIC COMPANY

MAIN OFFICE AND FACTORY — 2400 Block, Fulton St., Chicago 12, Ill.
NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

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CANADIAN ASSOCIATE

Canadian Line Materials Limited — Toronto 13, Canada

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It's a Pipe!

and it needs expert attention, too!

Why be irritated by improperly operating pipes when Pittsburgh Pipe Cleaner Company can diagnose your troubles and cure them so readily?

Our treatment includes—

Specialized tools
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These qualifications give us the background to do a professional pipe cleaning job for you.

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Do pipe stoppages rob you of time for more important work?

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427 MELWOOD STREET, PITTSBURGH 13, PENN.

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How BAILEY CONTROLS Save Money

MORE STEAM PER DOLLAR

FUEL

1. Average saving as reported by users is 5%.
2. Waste fuel automatically used when available by Multi-Fuel firing.
3. Flexibility of control simplifies switching to most economical fuel.

MAINTENANCE

1. Furnace wall repairs reduced by limiting maximum furnace temperature through close control of excess air.
2. Slagging of heating surfaces reduced to a minimum by accurate control of excess air.
3. Feed water pumps protected at low ratings by automatic by-pass control.
4. Possible damage to turbine from water carry-over avoided by feed water control.
5. Damage from excessive steam temperature avoided by proper control of excess air and superheat.
6. Burning of tubes insured against by proper control of feed water and excess air.

AUXILIARIES

Power required by fans is less since control continuously operates on minimum allowable excess air.

Power for feed pumps may be reduced through control of excess pressure by pump speed.

STEAM USE

1. Maintains Prime Mover efficiency by supplying steam at design pressure and temperature.
2. Improves process operation by controlling flow, pressure and temperature.

APPLICATION TO YOUR PLANT

It is worth your while to consider these modern methods for your plant—for money-saving, for greater safety and for improved power service. Call on your local Bailey Engineer to analyze your lay-out and make recommendations; or write for Bulletin 15-C giving further details on Bailey Meters and Controls. Bailey Meter Company, 1047 Ivanhoe Road, Cleveland 10, Ohio. In Canada—Bailey Meter Company Limited, Montreal. A-92A

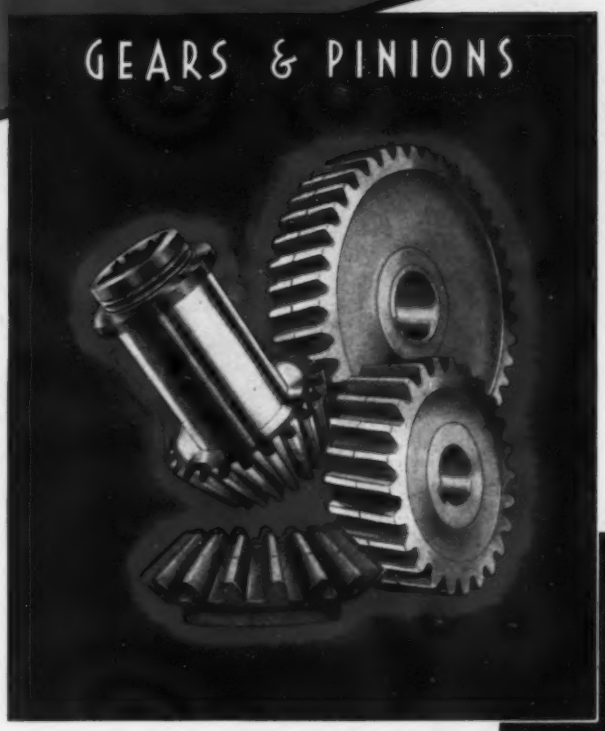
BAILEY METER COMPANY

1047 IVANHOE ROAD · · · CLEVELAND 10, OHIO

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

"TOOL STEEL" PROCESS



GEARS • PINIONS • WHEELS • ROLLS
and HARDENED PRODUCTS

insure lowest post-war costs through

Longer Wear and More Production

Ask our engineers for recommendations

**THE
TOOL STEEL GEAR & PINION
COMPANY**

CINCINNATI 16, OHIO

DESIGNER AND BUILDER OF STEEL PLANT EQUIPMENT

O. H. FURNACES
CONVERTERS
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MIXERS

from BLAST FURNACE *to*
INGOT POURING LADLE

INGOT CARS
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PENNSYLVANIA ENGINEERING WORKS

NEW CASTLE, PENNA.

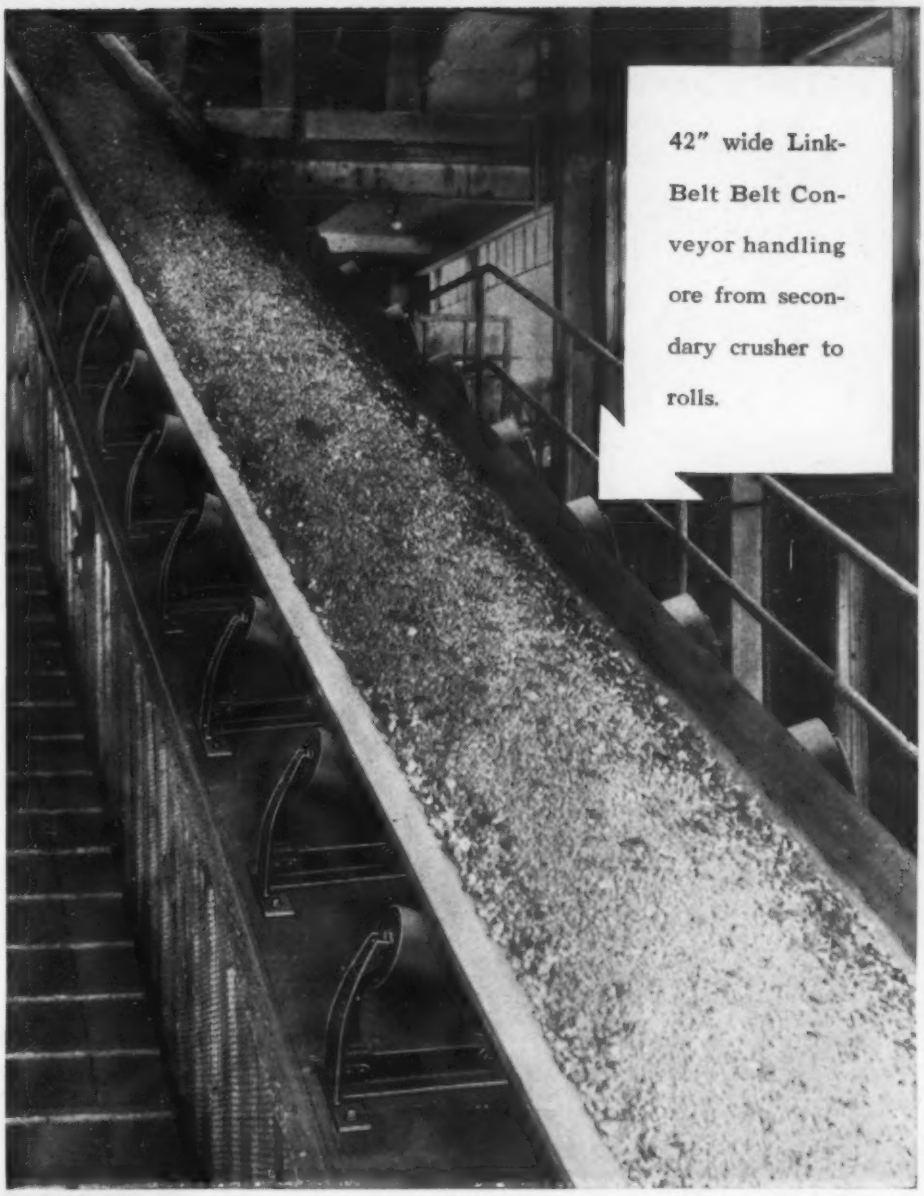
THE "ROAD" to EFFICIENT BELT CONVEYING

LINK-BELT

BELT CONVEYOR IDLERS

● Top performance in belt conveyors depends, in a great measure, upon the structure on which the load moves. So, begin at the beginning and make sure you select the right type. Link-Belt Roller Bearing Belt Conveyor Idlers are the outgrowth of almost 50 years of constant development. Engineering development that has kept pace with growing service needs, has achieved outstanding design in today's Link-Belt Idlers.

There are good reasons why they perform with minimum power and maintenance—operate smoothly and dependably, and add to the ordinary life of the conveyor belt. Catalog sent on request.



42" wide Link-Belt Belt Conveyor handling ore from secondary crusher to rolls.

Assure longer life to conveyor belts by using Link-Belt Self-Aligning Idlers. They automatically maintain the conveyor belt in a central carrying position without injury to its edges. Made in two types for regular or reversing travel.

LINK-BELT PRODUCTS INCLUDE: Conveyors and Elevators of all types—Belt, Apron, Pan, Bucket, Chain, Bulk-Flo, Sidekar-Karrier, Oscillating-Trough, Flight, Screw, etc. . . . Feeders . . . Vibrating Screens . . . Skip Hoists . . . Car Spotters . . . Silent and Roller Chain Drives . . . Speed Reducers . . . P.I.V. Gear Variable Speed Changers . . . Chains and Attachments of all types . . . Malleable Iron, Promal, and Steel . . . Sprockets . . . Gears . . . Clutches . . . Couplings . . . Base Plates . . . Take-Ups . . . Babbitted, Ball and Roller Bearings . . . Grease Cups . . . Safety Collars . . . Shafting, etc.—everything from one source to make your materials handling and power transmission machinery operate at peak efficiency. Send for Catalogs.

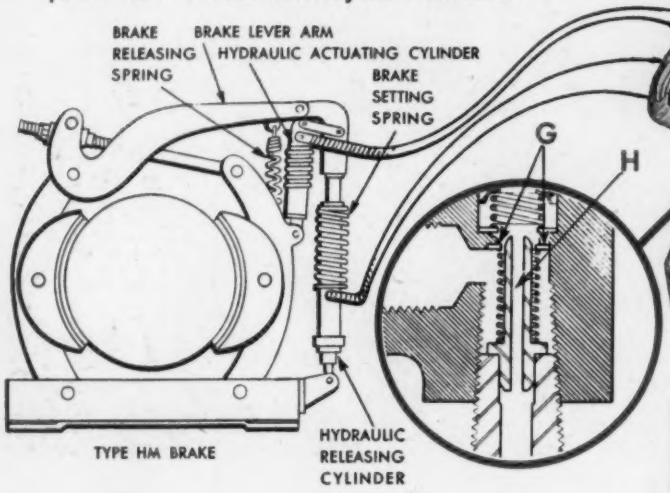
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8, Pittsburgh 19, Cleveland 13, Detroit 4, New York 7. Other Offices in Principal Cities.

Only the Wagner type HM HYDRAULIC CRANE-BRIDGE BRAKE

provides ALL THREE requirements of a PERFECT BRAKING SYSTEM

1. **FOOT-CONTROLLED HYDRAULIC BRAKE** for service stops
2. **AUTOMATIC SPRING-SET BRAKE** for parking
3. **AUTOMATIC CUSHIONED EMERGENCY STOPS** when power fails or crane runs beyond safe limits



BRAKE CONTROL UNIT

MAGNET (C) controlling plunger (D) is energized when switch (J) closes line circuit (L).

PLUNGER (D) closes escape port in sealing cup (F). Fluid entering port (E) passes readily through sealing cup (F), but cannot return while magnet is energized.

METERING DISC (G) meters the escape of fluid when magnet is de-energized—thus releasing the spring-set brake at a predetermined rate to effect a smooth, cushioned stop.

SWITCH (J) is operated by plunger (I) which is actuated by fluid entering through tube (H). This tube directs the flow of fluid to assure a full release of the spring-set brake before line circuit is closed and magnet is energized.

PILOT CIRCUIT (K) is completed when line circuit is closed, lighting pilot light in control cab—notifying operator that spring-set brake is released and bridge brake is ready to operate.

IT'S one thing for a crane-bridge brake to set automatically when the power fails—but it is another matter for the brake to set *smoothly* and bring the load to a *cushioned* stop! That's how the Wagner type HM Hydraulic Crane-Bridge Brake stops the bridge and its load: smoothly and safely. There's no jerk, no strain on the machinery, no undue swinging of the suspended load.

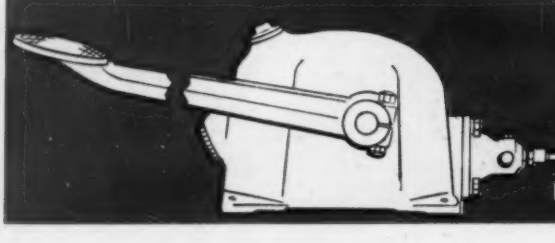
A tiny valve in the HM brake control unit is the secret to the cushioned stops. As the cut-away photograph at the right reveals, the hydraulic fluid in the parking-brake cylinder escapes thru a restricted opening, so that the full force of the spring is released at a rate accurately predetermined to provide a smooth, cushioned stop.

The control unit, of which the "Cushion-Stop Valve" is a part, consists of a transformer (A) and a selenium rectifier cell (B) that converts alternating current to 12 volts direct current (the direct-current unit resistors are substituted to reduce the direct-current voltage), a magnetic valve which traps hydraulic fluid in the spring-set brake cylinder, the "cushioned-stop valve", and a pressure switch. The entire unit is simple in design, with very little wear factor and hence very little maintenance involved. The short description at the right will help you to understand how the brake control unit works.

The brake control unit is but one of many features making the Wagner type HM Hydraulic Brake the ideal brake for crane bridges. Among other features are: (1) pushbutton control in crane cab enables operator to set brake as desired, (2) signal light indicates when parking brake is released, (3) brake control can be interlocked with motor pilot-circuit to insure release of brake before starting motor, (4) brake can be set at any time during cycle of crane operation by use of limit switches, (5) can be applied to almost any type of industrial crane equipment.

For a complete discussion of the Wagner type HM Hydraulic Crane-Bridge Brake, read Bulletin IU-186, which we'll gladly send you on request.

145-9



Wagner Electric Corporation

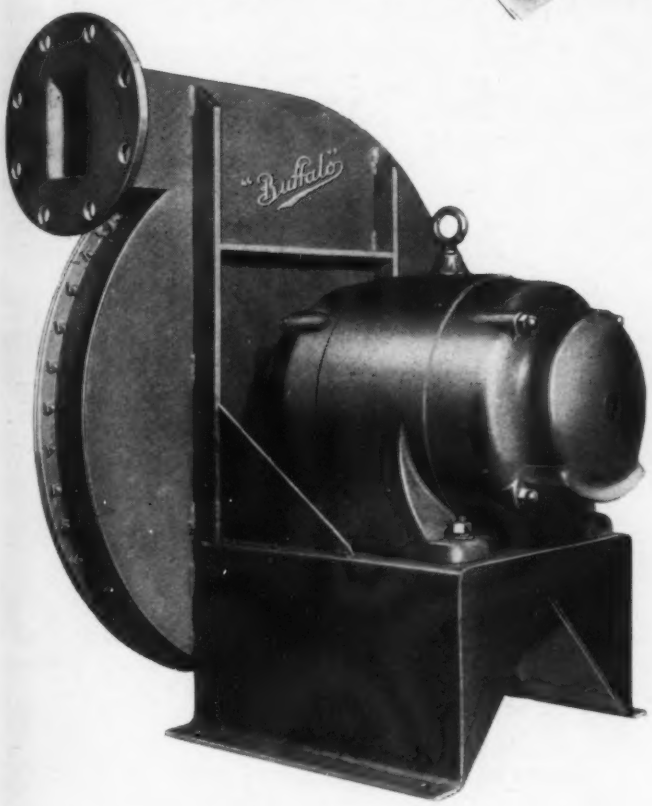
ESTABLISHED 1891

6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

In Canada: Wagner Electric at Leaside, Ontario

ELECTRICAL AND AUTOMOTIVE PRODUCTS

ANOTHER MILESTONE *in Air Handling*



"Buffalo" HIGH PRESSURE BLOWERS

These new-type blowers were developed by Buffalo engineers to meet the needs of industrial applications where high air pressure is required at low to moderate air volumes. Their wide range of applications includes the handling of air for oil or gas furnaces . . . on high pressure operations in glass, steel and chemical plants . . . for scale and water blow-off work . . . in experimental problems. Suitable for pressures up to 4 lbs. per square inch. Heavy welded steel plate construction without bulkiness; rigid, scientifically balanced rotors; economical to operate and maintain. Engineering data in Bulletin 3553.

"Buffalo" "First For Fans"

BUFFALO FORGE CO.

173 Mortimer St.
BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Ever since the first 'Surface' One-Way Fired Soaking Pit was installed in 1926, our engineers have been working with steel men in the continuous development of metal heating equipment to meet the prevailing production need.

Today, 'Surface' One-Way Fired Soaking Pits incorporate the most modern features in design and operation to make possible high quality as well as quantity tonnage.

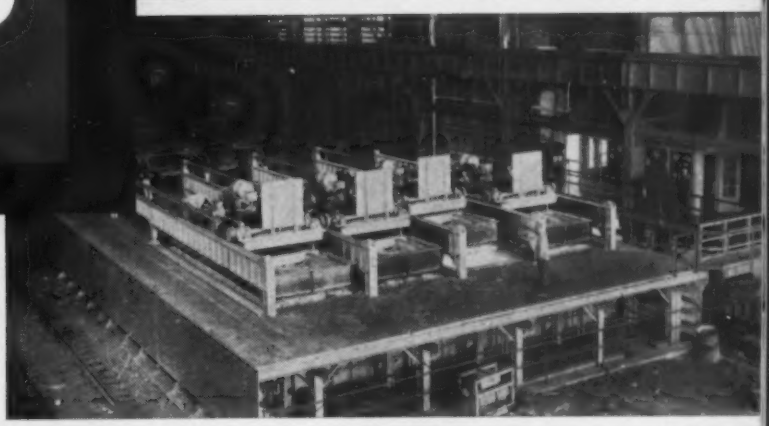
Most significant is the fact that during the nineteen years of 'Surface' Pit engineering, the One-Way Firing principle has remained the most satisfactory method of ingot heating. It is convincing to see 'Surface' Pits in operation. Furthermore, 145 One-Way Fired Pit installations have been made since 1936... 66 since 1942, which is most indicative of an industry trend to proved heating methods and equipment.

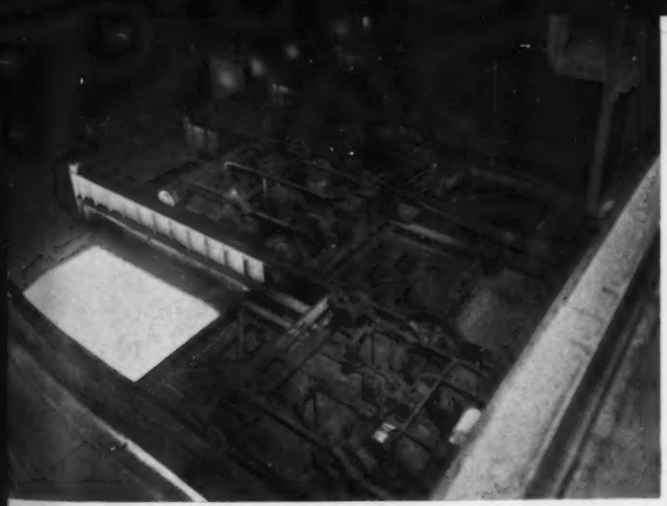
These outstanding advantages are offered in 'Surface' One-Way Fired Pits: Simplest Construction; Greater Capacity; Most Efficient Firing; Best Heat Distribution, and Lowest Maintenance. Ask a 'Surface' Engineer for details.

'SURFACE' ONE-WAY FIRED PITS

in the country's leading

STEEL MILLS





'Surface'

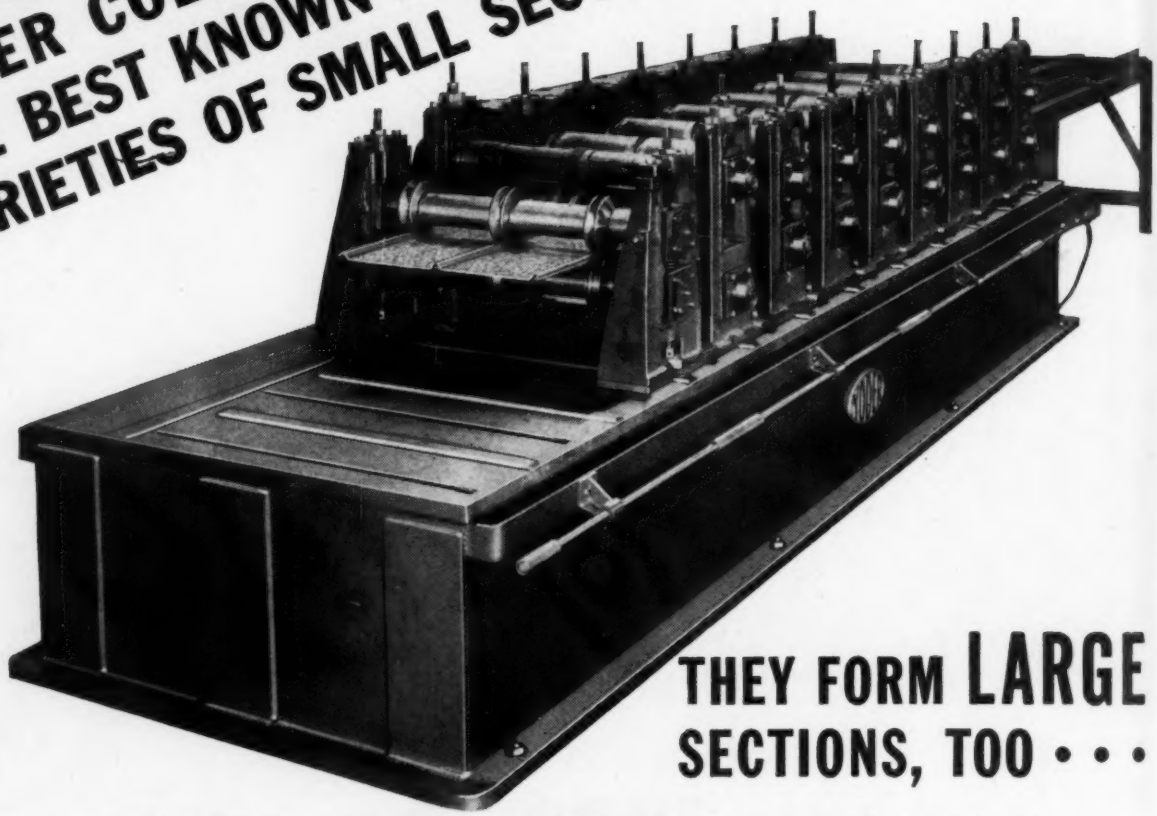
SURFACE COMBUSTION CORPORATION

TOLEDO 1, OHIO

"WHEREVER HEAT IS USED IN INDUSTRY
...FROM INGOT TO FINISHED PRODUCT"

YODER COLD-ROLL FORMING MACHINES ARE BEST KNOWN FOR THE THOUSANDS OF VARIETIES OF SMALL SECTIONS THEY FORM

BUT—



THEY FORM LARGE SECTIONS, TOO • • •

Standard Yoder roll stands, assembled on wide bases with special wide rolls, are profitably used in the high production of formed sections up to 30 inches wide (stock size). Typical examples would be—roofing sections, refrigerator shells, steel auto body components, many types of corrugated sections, steel wall panels and a variety of beaded, channeled, flanged or crowned section for special purposes, rapidly formed from flat or coiled sheet stock in any required gauge. Let a Yoder engineer show you how this or other Yoder Metal Working Machinery can cut costs in YOUR production.

THE YODER COMPANY
5526 WALWORTH AVE., CLEVELAND 2, OHIO

METAL • WORKING • PRODUCTION • MACHINERY
ENGINEERING
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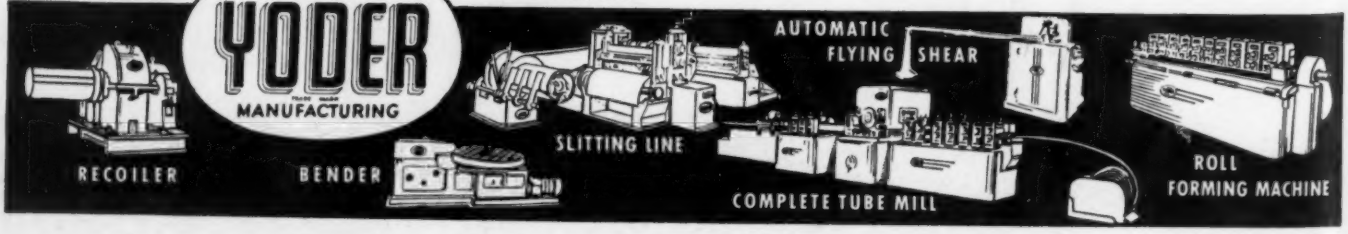
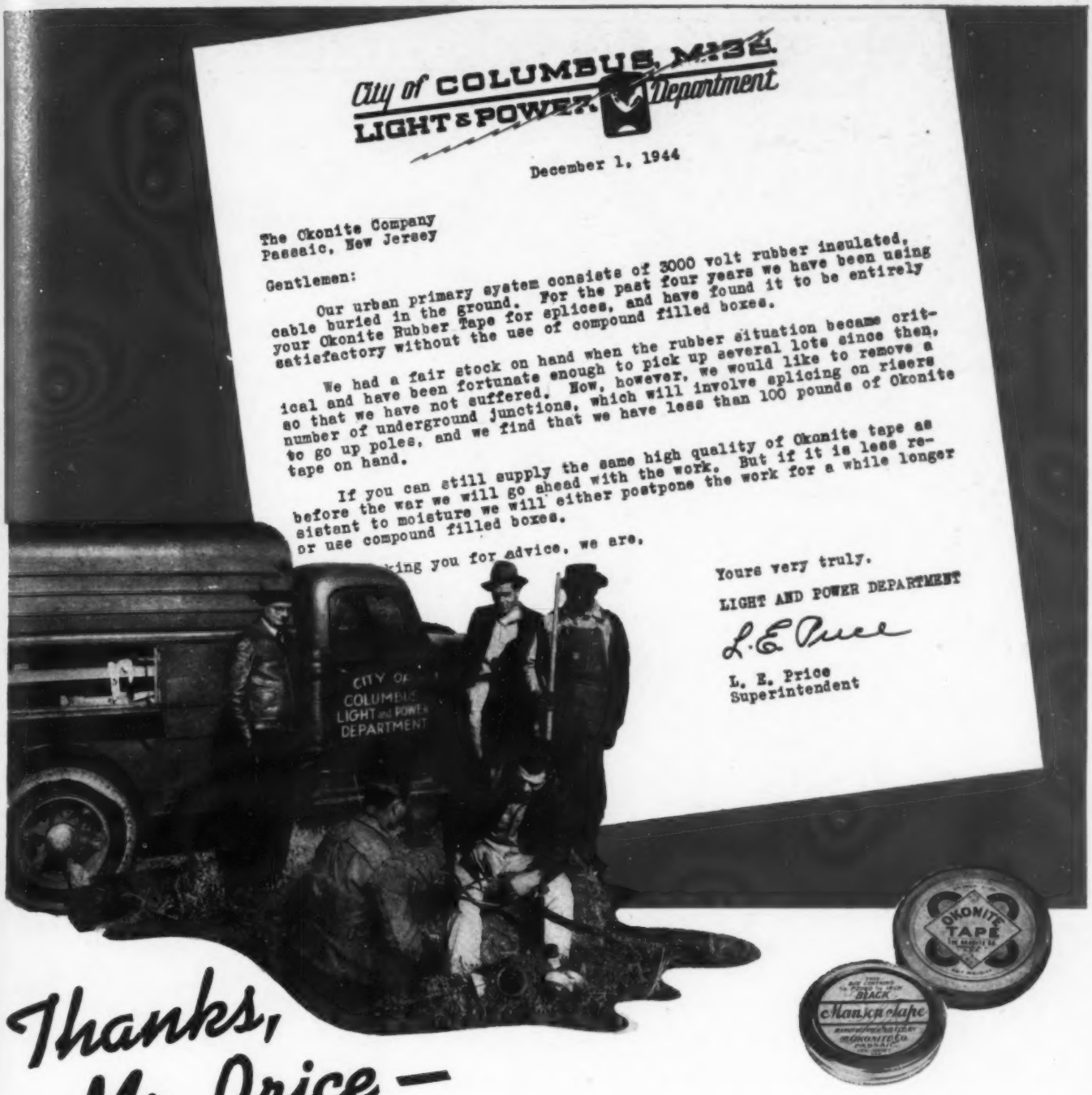



City of COLUMBUS, MISS.
LIGHT & POWER Department
December 1, 1944
The Okonite Company
Passaic, New Jersey
Gentlemen:
Our urban primary system consists of 3000 volt rubber insulated, cable buried in the ground. For the past four years we have been using your Okonite Rubber Tape for splices, and have found it to be entirely satisfactory without the use of compound filled boxes.
We had a fair stock on hand when the rubber situation became critical and have been fortunate enough to pick up several lots since then, so that we have not suffered. Now, however, we would like to remove a number of underground junctions, which will involve splicing on risers to go up poles, and we find that we have less than 100 pounds of Okonite tape on hand.
If you can still supply the same high quality of Okonite tape as before the war we will go ahead with the work. But if it is less resistant to moisture we will either postpone the work for a while longer or use compound filled boxes.
king you for advice, we are,
Yours very truly,
LIGHT AND POWER DEPARTMENT
L. E. Price
Superintendent
CITY OF COLUMBUS LIGHT and POWER DEPARTMENT
OKONITE TAPE
Manson Tape

Thanks, Mr. Price —

We at Okonite like to get letters that tell us about good jobs done by our products. Naturally that goes for tapes as well as cables. And — also naturally — we like to get orders. Remain assured that in Okonite and Manson tapes we have consistently refused to use substitutes, and any such tapes you obtain are "the same high quality . . . as before the war."

But we haven't been able to fill all our orders for Okonite and Manson tape because of government restrictions on critical rubber. When Okonite and Manson tapes are again available to all, there will have been no let-down in what they have always offered utilities, railroads, and other industry. Long service life, for example, moisture resistance . . . better splicing . . . toughness and weathering qualities . . . in short, what it takes to give a joint the best insulation and mechanical protection that money can buy.

• When unable to obtain Okonite and Manson tapes, many of our customers are obtaining satisfactory results from our Dundee tapes or our Hazard Division's Panther and Dragon Tapes. The Okonite Company, Passaic, New Jersey.

OKONITE and MANSON TAPES
wherever electrical splices are needed

B&W DIRECT-FIRING PULVERIZED-COAL CIRCULATING SYSTEM

SERVICE-CHECKED on all these points

✔ SIMPLE INSTALLATION
Only one pulverizer with a single circulating line for pulverized coal required by the system.

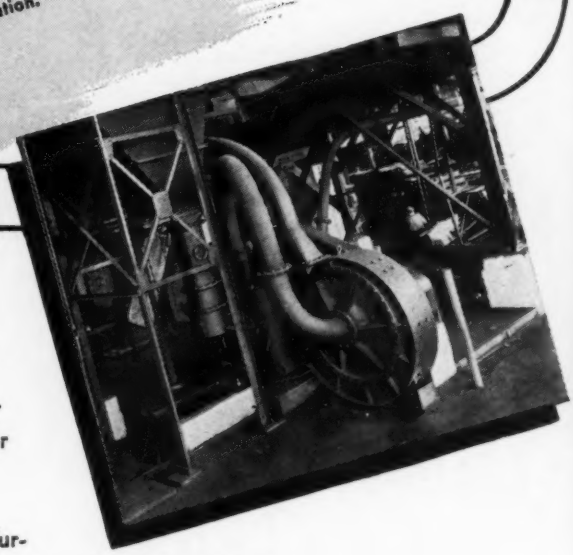
✔ SAVES FLOOR SPACE
Space at furnaces clear for product handling — pulverizer at a distance — circulating loop overhead.

✔ FLEXIBLE MULTI-FURNACE OPERATION
As many take-offs to burners as needed. Burners may be turned on and off as desired.

✔ UNIFORM FURNACE TEMPERATURE
Temperatures easily controlled, by methods similar to those used with gas and oil firing.

✔ SUSTAINED FURNACE CAPACITY
Pulverizer maintains its rated capacity in coal to the fineness required by the installation.

✔ INCREASED FURNACE OUTPUT
Existing installations show shorter heating cycles with lower fuel consumption per ton of castings.



FOR SIMPLIFIED FIRING OF METALLURGICAL FURNACES, investigate the B&W Direct-Firing Pulverized-Coal Circulating System. Its economy and efficiency have been proved on billet heating, reheating, forge, malleable-iron annealing, zinc fuming and other types of metallurgical furnaces.

This method of firing is equally applicable to other metallurgical furnaces, including ingot, bloom and billet heating furnaces; normalizing furnaces; copper, lead, and zinc melting furnaces; multiples of small units such as small forge furnaces and process heating furnaces in chemical industries.

The same B&W pulverizers, used in this system are also providing economical *direct-firing* of individual furnaces. For further details, write for Bulletin 3-333.

B&W

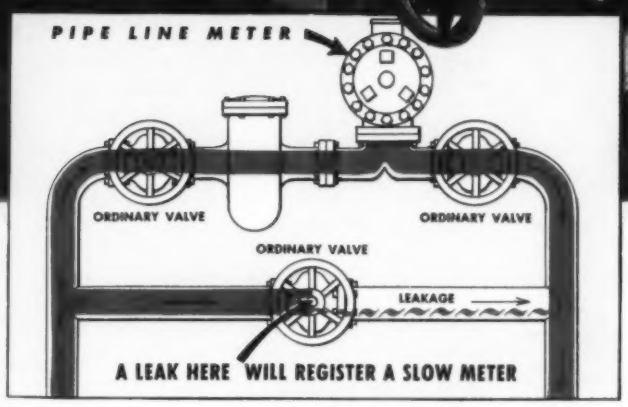
BABCOCK & WILCOX

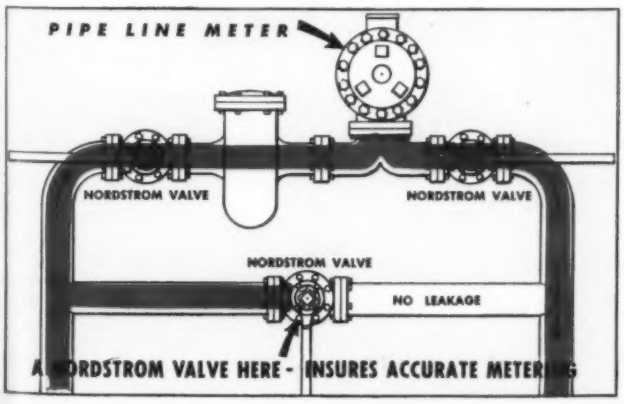
THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

PM-108

ARE THERE *GREMLINS* IN YOUR BY-PASS?





LEAKY VALVES ON BY-PASSES CAUSE INACCURATE METERING

LEAKING gate valves on by-passes cause under-registration of the meter. This is especially true on pipe lines and at pipe line terminals using large oil meters. Losses can run as high as 5% to 10%. Unless the operator is aware of this leakage, the meter is usually blamed for inaccuracy. It isn't the meter's fault. A tight, leak-proof valve on the by-pass is absolutely necessary.

To assure complete satisfaction from any meter setting, use Nordstrom Valves on the by-pass. Not a drop of the line fluid (or gas) can pass a closed Nordstrom. If your meters are running slow, check your by-pass. *Change to Nordstroms.* Gas companies have learned by experience that Nordstrom Valves are essential on the by-pass. Many gas operators have made Nordstroms standard equipment for all meter settings.

NORDSTROM *Lubricated* **VALVES**

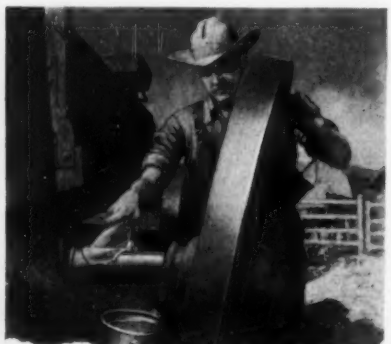
A valve principle, centuries-old, becomes indispensable in many plants

OLDEST of devices used by man for the control of fluids in closed conduits is the tapered plug valve. In the form of the common "stop-cock" it has been in general use since very early times, but only in the smaller sizes and for moderate services.

It was not until the advent of the Nordstrom pressure-lubrication principle (1916) that the plug valve became available for the full range of heavy-duty process and industrial uses. Since that time, this principle has been built into Nordstrom Valves of many sizes, styles and materials to meet the demands of practically every branch of the piping industry.

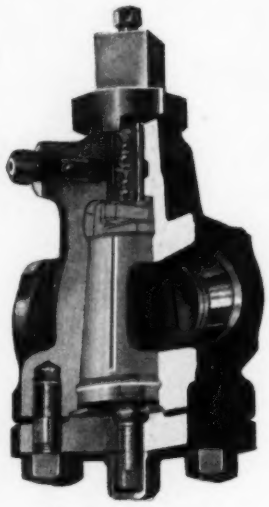
FUNCTIONS OF VALVE LUBRICATION

The functions of pressure lubrication in Nordstrom Valves are: (1) *Hydraulic action,* keeping the plug in free working condition; (2) *Maintenance of positive seal* against internal and external leakage; (3) *Free turning,* even of the largest sizes and against heavy differential pressure; (4) *Protection of working surfaces* from wear and corrosion. Thus, the Nordstrom principle of lubrication has made it possible to take full advantage of the inherent simplicity, compactness and positive rotary action of the tapered plug valves.



LUBRICATION IS VITAL

Lubrication of a tapered axle skein is necessary for easy rotation and long life of the metal contacting surfaces. Lubrication is even more important in a valve. For extra long life lubrication must be used.



Hypreseal Type

TAPERED PLUG

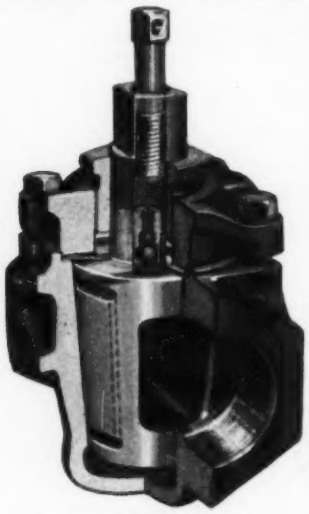
The tapered form of plug and seat provides an intimate fit, regardless of the thickness of lubricant film. Even with a complete absence of lubricant, the plug and body have a ground-joint, metal-to-metal contact. The positive rotary action of the tapered plug valve provides inherent protection of the seating surfaces against corrosion, erosion or accumulation of solids.

LUBRICANT "JACKING"

In all Nordstrom Valves, lubricant forced in under pressure produces a momentary lifting movement of the plug, which overcomes any adhesion and, because of the taper, creates a small space for a lubricant film between the plug and body.

RESILIENT SEATING

In every type of Nordstrom Valve, the arrangement which holds the plug in place has a small, but highly important, degree of resiliency. This prevents binding and allows the lubricant "jacking" action to function properly.



Regular Screwed Gland Type

"SEALDPORT"

In the Nordstrom patented *"Sealdport"* system, the grooves are divided between the body and plug in such manner that the exposed groove sections are disconnected from the lubricant supply before they are brought in contact with the line-fluid space. These grooves are automatically reconnected when the plug is brought to the fully open or closed position. Ports are completely surrounded by a lubricant film, preventing leakage past any part of the port boundary.

Nordstrom LUBRICATED VALVES

Sealdport Lubrication

MERCO NORDSTROM VALVE COMPANY — *A Subsidiary of Pittsburgh Equitable Meter Company*

Main Offices: 400 Lexington Avenue, Pittsburgh 8, Penna. • *Branches:* Atlanta, Boston, Brooklyn, Buffalo, Chicago, Columbia, Houston, Kansas City, Los Angeles, New York City, Oakland, San Francisco, Seattle, Tulsa • *Canadian Licensees:* Peacock Bros., Ltd., Montreal
European Licensees: Audley Engineering Co., Ltd., Newport, Shropshire, England • *South American Representative:* The Armco Int'l Corp. • *Main Office:* Middletown, O.
PRODUCTS: Nordstrom Lubricated Valves; Air, Curb and Meter Cocks • Nordco Valve Lubricants • EMCO Gas Meters • EMCO-McGaughy Integrators
EMCO Regulators • Pittsburgh-National Meters for Gasoline, Grease, Oil, Water and other Liquids • Stupakoff Bottom Hole Gauges

AN IDEA IN MOTOR DESIGN

pioneered 41 years ago

In 1904, Crocker-Wheeler built the first motors specifically designed for auxiliary drives in steel mills. For fully a decade, steel-mill engineers had been experimenting — trying to find a motor that could withstand heavy overloads, moisture, dust, fumes and terrific heat. Partially-enclosed, street railway motors were tried . . . and failed. Sooner or later their insulation proved inadequate.

Then Crocker-Wheeler engineers had an idea: Why not enclose the armature and windings completely, and strengthen the insulation to withstand the extreme temperatures? A motor was designed, built, tested, tried out . . . and proved a success.

Today, thousands of motors — following this same basic design idea—are in use throughout the world. Direct descendant of the original motor is the Crocker-Wheeler Type *Numerical "W"*— built to meet A.I.S.E. standardized dimensions and ratings.

Mica and glass insulate against heat, vacuum impregnation with high-grade varnish protects the windings from corrosive fumes; a thick steel housing keeps out dirt. Extremely low armature flywheel effect, permits rapid acceleration with minimum power loss. Deep commutator bars with wide solid risers assure long commutator life. Brazing eliminates possibility of loose field coil connections. Heavy malleable iron hinged inspection cover provides easy accessibility.

Send for complete details of Crocker-Wheeler mill motors. Please write on your company letterhead.

CW-6

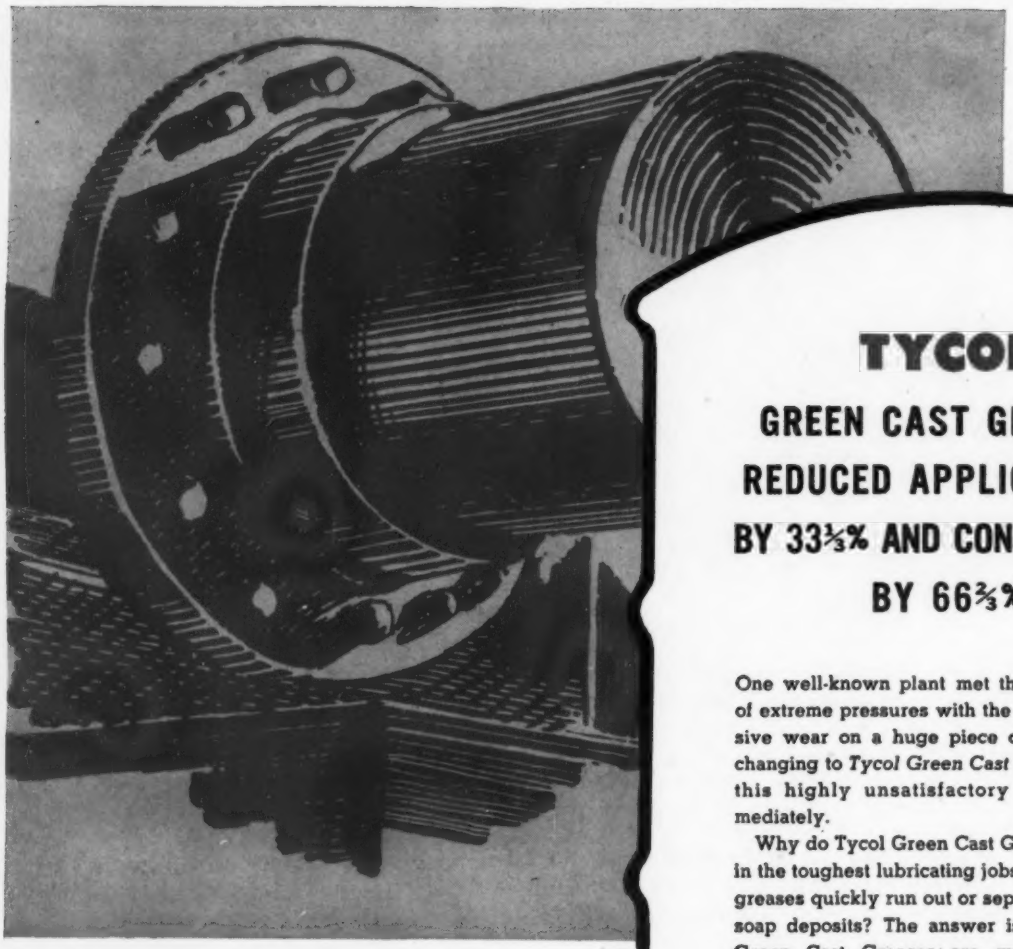
CROCKER-WHEELER

A DIVISION OF JOSHUA HENDY IRON WORKS, AMPERE 2C, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON

SQUIRREL CAGE MOTORS WOUND ROTOR MOTORS DIRECT CURRENT MOTORS GENERATORS FLEXIBLE COUPLINGS

"Engineered Lubrication"...



TYCOL

GREEN CAST GREASES REDUCED APPLICATIONS BY 33⅓% AND CONSUMPTION BY 66⅔%

One well-known plant met the usual trouble of extreme pressures with the resultant excessive wear on a huge piece of equipment — changing to *Tycol Green Cast Grease* stopped this highly unsatisfactory condition immediately.

Why do Tycol Green Cast Greases stand up in the toughest lubricating jobs — where other greases quickly run out or separate into caked soap deposits? The answer is simple. Tycol Green Cast Greases are made from high quality cylinder stock and well refined neutral oil combined with a minimum of soap for a given consistency. Green Cast Grease is water repellent . . . and is engineered to "take it" under all conditions.

A Tide Water Engineer will be glad to give you full information.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned as soon as possible.

TIDE WATER

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL
Eastern Division:
17 Battery Place, New York 4, N. Y.

...the TYCOL way

CUTS DOWN REPAIRS... SPEEDS UP PRODUCTION

If you want peak efficiency . . . low-cost operation – turn to Tycol "Engineered Lubrication" for all-important help in securing these results. Why? Because each Tycol lubricant is scientifically engineered to meet definite service conditions . . . to reduce wear and maintenance costs to a minimum. That's why so many successful operators have turned to Tycol for low-cost lubrication.

In developing this individualized line of lubricants, Tide Water has complete control over its own products – from oil field, through transportation, to refining. The most modern processes are used to refine selected crudes . . . to blend and compound Tycol's "specifically engineered" oils and greases.

For complete information regarding the specific oils and greases best suited to meet your requirements, call or write your nearest Tide Water Associated office. There a Tide Water engineer, thoroughly experienced in all phases of industrial lubrication, will give you the full benefit of his knowledge.

Have you received your copy of "Lubricania"?

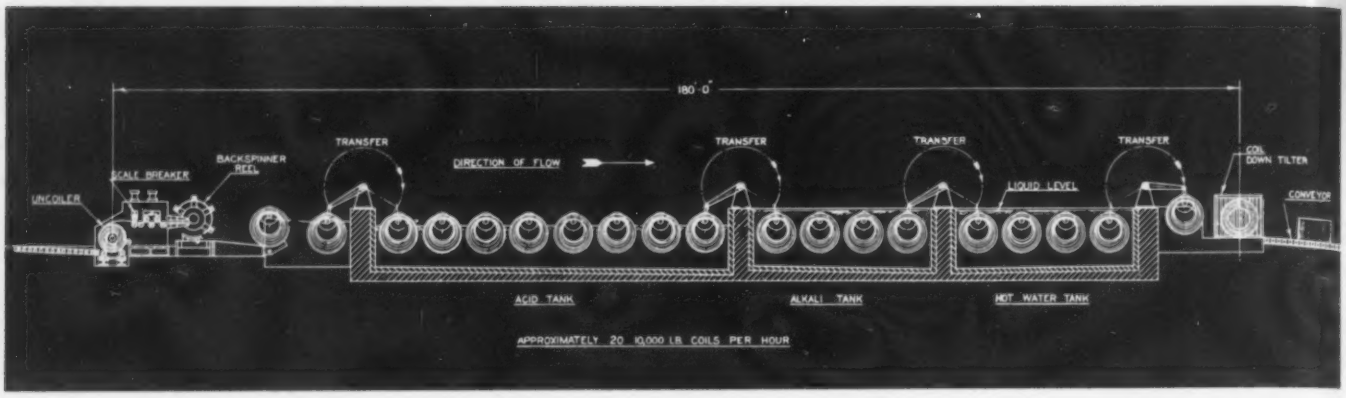
This informative handbook, "Tide Water Associated Lubricania", gives clear, concise descriptions of the basic tests used to determine important lubrication properties – Pour Points, Viscosity, Neutralization, and many others. For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

ASSOCIATED OIL COMPANY

Principal Branch Offices:

Boston • Philadelphia • Pittsburgh • Charlotte, N. C.

CONTINUOUS STRIP PICKLING IN COILS



The coils follow each other through the acid, alkali and wash tanks at approximately 20 coils per hour. The frequent aeration of the coils produces a product of superior quality.

MINIMUM FLOOR SPACE • LOW OPERATING COST

LARGE TONNAGE • SUPERIOR PRODUCT

Sole Licensee
Under Greer Patents

THE ARMS-FRANKLIN CORPORATION

Engineers and Builders of Rolling Mill Machinery

YOUNGSTOWN 3, OHIO

NEWS SUPPLEMENT September, 1945

Equipment
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Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

SAFETY RECORD SET BY REPUBLIC'S OPEN HEARTH DEPARTMENT AT YOUNGSTOWN

▲ A new world's record for safety has been chalked up by employees in the open hearth furnaces at Republic Steel Corporation's Youngstown district plant, who have worked 1,156,713 man-hours since August 7, 1944, without a single lost-time accident.

Roy L. Leventry, Republic's Youngstown district manager, received congratulations from the National Safety Council on the achievement of the 300-man furnace crew under open hearth superintendent B. D. McCarthy. The message pointed out that the previous open hearth record was 833,000 man-hours without an accident. The new record is advancing daily as the crew continues to work without accidents.

The 15 open hearth furnaces at the Youngstown plant have averaged 341.8 tons of steel per day per operating furnace during the period, when the highest month's output was 129,078 tons in February.

IMPROVED DESIGN OF DOLOMITE MACHINE GIVES GREATER SPEED AND EASY HANDLING

▲ The manufacture of an improved dolomite throwing machine has just been announced by the Blaw-Knox Company. There is no change in principle, because the essential parts of the machine have been, from the first, of simple and effective design, but the improvements enable the machine to be handled easier and to perform its duties faster.

The throwing mechanism and the hopper are mounted on a self-propelled carriage, enabling the machine to move under its own power along the charging buggy track. Power is obtained by plugging in the power cable to stations located near each furnace, or by built-in Diesel generator units.

The flexibility in movement of a machine of this type enables the operator to keep the machine out of the way of the charging buggies without having to depend on the availability of the charging floor crane.

Dolomite machine hoppers of the improved variety now have capacities six or more times those of the earliest machines. Thus more furnaces can be served between fills.

The new machine is built to withstand rough handling. Improvements have been made to the car drive mechanism, to the material throwing mechanism, and to the general construction. The operator's range of vision has been increased, enabling him to handle the machine from a much more comfortable position than formerly.

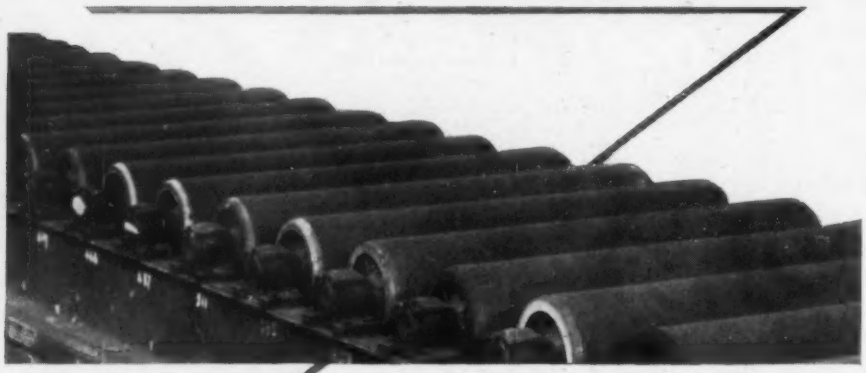
Improvements in the throwing mechanism are as follows:

In the new machine the stream of dolomite is under complete control of the operator. Motor speed can be adjusted so that the operator controls the trajectory of the stream. Elevation of the stream, and movements to right and left, are controlled from the operating handle. Such complete control enables the operator to throw the material into the furnace to any desired location.

In spooning up front wall and banking doors, the stream of dolomite is directed against a spoon in such a manner that it is deflected as desired. The spoon supports are fully adjustable, so that the operator can select the most favorable spoon position.

Operating visibility is excellent with the new dolomite throwing machine perfected by the Blaw-Knox Company. The machine shown is equipped with a diesel-electric generator set which provides the power needed to propel the machine along its route without having to depend on the charging floor crane, which was generally used to move older machines. The capacity of the bin shown is 450 cu ft, level full.

SCHLOEMANN



"MOTOR ROLLERS"

for Day-after-Day

EFFICIENCY

Schloemann "Motor Rollers" are designed for steel mill tables, particularly for run out and shear tables for all types of mills, as well as for tables between stands.

Each "Motor Roller" is individually driven by an inverted, rugged squirrel cage motor with the heat resisting winding mounted on a stationary shaft leaving the squirrel cage with its roller housing free to rotate on anti-friction bearings. Each unit is entirely self-contained, providing proper alignment under all conditions at a maximum of freedom and economy in table design.

Our engineers are prepared to assist you with any mill table problem. We invite your inquiries, requests for information or consultation.

SCHLOEMANN
ENGINEERING CORPORATION
1102 EMPIRE BUILDING . . . . . PITTSBURGH 22, PA.
HYDRAULIC PRESSES • ROLLING MILL MACHINERY

The gate controlling the flow of material has also been improved, so that it provides a convenient and effective means of measuring the amount of material flowing into the throwing mechanism, eliminating the spilling of dolomite between the hopper and the throwing mechanism.

CHIKSAN ESTABLISHES EXPORT AFFILIATE

▲ Increased activity in export markets is anticipated by the Chiksan Company, Brea, California, with the announcement of the establishment of an affiliate company to handle export sales. The new company, Chiksan Export Company, will headquarter in Breâ, with branch offices in New York and Houston. The cable address is "Chiksan."

W. Edgar Spear, president of the Chiksan Company, heads the new export company in the same position, with Lee J. Laird, Chiksan vice-president and sales manager, also in charge of export sales. The New York office will be managed by H. A. Maland and the Houston office will be under the management of G. R. Winder who transfers to Houston from the Chiksan home office.

The company has also announced the appointment of Well Equipment Manufacturing Corporation, Houston, Texas, as exclusive Chiksan representatives for the states of Texas, Oklahoma and Kansas and portions of Mississippi, Arkansas and New Mexico.

AGENCIES SET UP FOR PEERLESS PUMPS

▲In preparation for postwar distribution of water pumps, Peerless Pump Division of Food Machinery Corporation has rearranged territorial distribution by the establishment of five sales districts.

Warner G. Vaughan has been appointed Atlantic district sales manager, with offices established in Suburban Square, Ardmore, Pennsylvania. Mr. Vaughan was for several years the company's representative in Washington, D. C., negotiating a vast quantity of Government contracts for Peerless Pumps and "Water Buffaloes."

The south-eastern territory has been placed under the management of Charles E. Tierney with offices in

Blair Building, Decatur, Georgia. He is well known in hydraulic circles, having devoted many years to pump engineering.

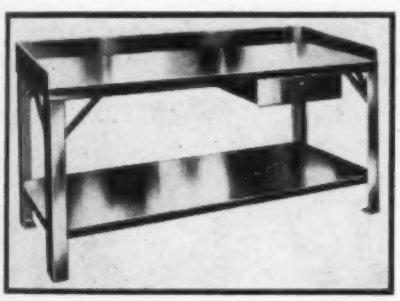
Edward W. Pierce will continue in charge of the central territory and as district sales manager is making his headquarters at the Peerless Canton, Ohio, works.

The southwestern territory has for its district sales manager William E. Griffin, with headquarters in Plainview, Texas.

B. A. Tucker is Pacific district sales manager, with headquarters in Los Angeles, California. Mr. Tucker has spent a lifetime in the pump business and for several years past was manager of the Fresno, California, division.

STEEL BENCHES PROVIDE FLEXIBLE WORKING PLAN

▲ Streamlined design, sturdier construction and numerous available extras are features of the improved Equipto 12-gauge steel work bench announced by Equipto, Division of Aurora Equipment Company, Aurora, Illinois. It may be furnished without back and side railings for use as a packing bench.



All four flanges of the bench are formed into a boxed edge for utmost rigidity. A second 12-gauge steel plate may be tack welded onto top for vise reinforcement. The bench is highly suitable for both work bench use and for supporting light machine tools. The four feet have holes to permit fastening to floor if desired. It is available in 42 inch and 6 foot lengths, 34 inches high and 28 inches deep on short deliveries and without priority.

It can be furnished as a plain work bench with 12-gauge steel top and with bottom tray, back and side railings, drawers with padlock attachment, adjustable 3-compartment tray for drawer. Benches may be used side by side and back to back forming larger working surfaces in a minimum of floor space.

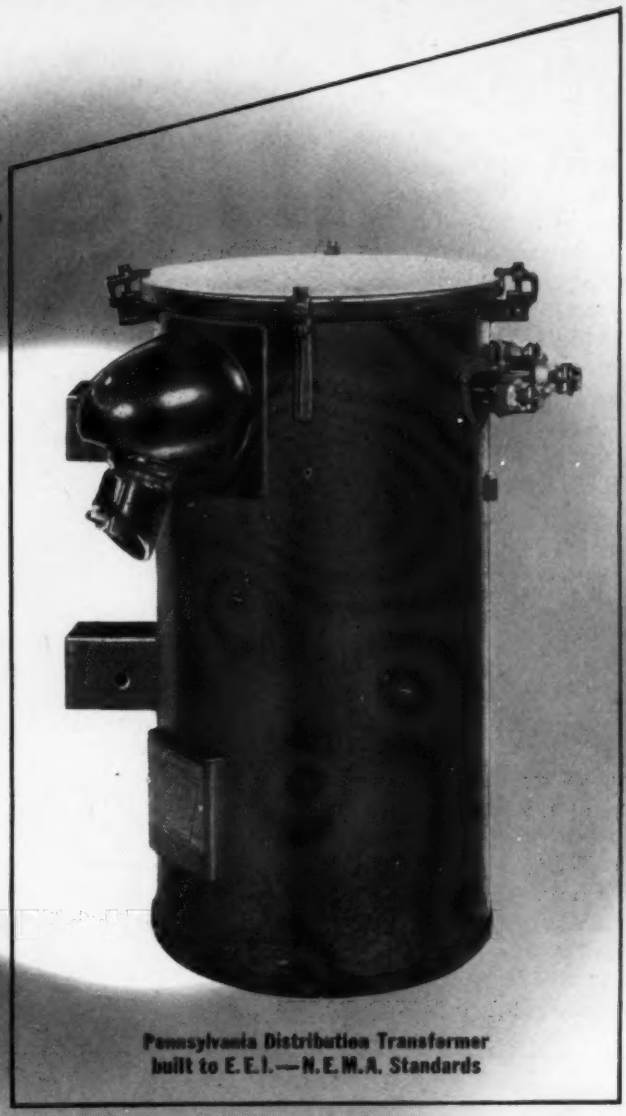
BB_2 = Double rows of Ball Bearings
EP = Effective Packing Element
P/V = Pressure or Vacuum
LT = Low Torque under all conditions.

Perfect flexibility with low torque is assured in every CHIKSAN *Ball-Bearing* Swivel. Yet Chiksan design and construction are so sound they can be expressed in a simple formula. There is nothing to tighten or adjust... no stuffing boxes to put the brakes on easy turning and thus produce excessive strains on pipe lines and fittings. Smooth, easy turning throughout 360° is provided in one, two and three planes. Packing Element is so effective the same Swivel may be used for either pressure or vacuum service... for loading or unloading. Chiksan *Ball-Bearing* Swivels are built for pressures to 3,000 p.s.i. and varying temperatures. Write for latest catalog.

Chiksan Representatives in Principal Cities
Distributed Nationally by Crane Co.

CHIKSAN TRADE MARK REG. BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES
CHIKSAN COMPANY BREA, CALIFORNIA

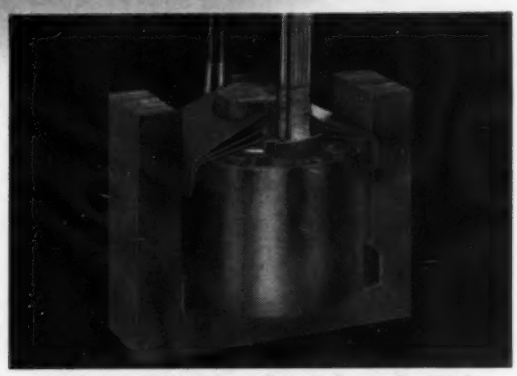
Every Pennsylvania Distribution Transformer gives you these electrical and mechanical advantages



Pennsylvania Distribution Transformer built to E.E.I.—N.E.M.A. Standards

- Core is built up of individual laminations varnished on both sides. It operates at a low density which results in low exciting current at normal voltage as well as at over voltages.
- Circular Coils are wound tightly with uniform tension, eliminating possibility of stretching the wire and injuring the insulation.
- Coils are mounted concentrically on Core and held firmly in place, thus eliminating possibility of movement during transportation or in service.
- High Voltage and Low Voltage Coils are readily removable from Core as a unit, permitting minor repairs or replacement of Coils with minimum time and expense.
- Generous size of Core and Coils results in high, short-time overload capacity.

A thorough knowledge of transformer design, supplemented by a careful analysis of operating and maintenance problems, have resulted in many desirable operating features being incorporated in Pennsylvania Distribution Transformers. Some of these are listed above.



Coil mounted firmly on Core before yoke steel is built in.

Core and Coil unit ready for assembly.

Pennsylvania TRANSFORMER COMPANY

808 RIDGE AVENUE, N. S., PITTSBURGH 12, PA.

NEW VALVE LUBRICANT FOR SEVERE SERVICE

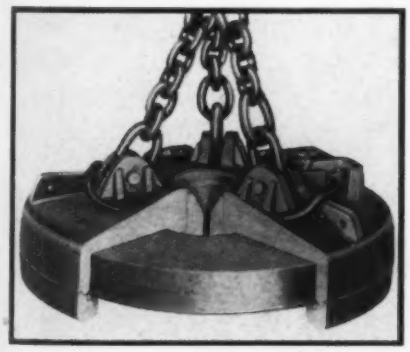
▲ Merco Nordstrom Valve Company is now the exclusive distributor of a new valve lubricant which possesses unusual properties advantageous for a number of severe services. This lubricant is a Dow Corning silicone product and is identified as Nordcoseal Lubricant No. DC234-S.

The lubricant is colorless and one of its outstanding properties is that its viscosity changes only slightly over a very wide temperature range. It is recommended for working temperatures ranging from −40 F to +400 F. Due to its extremely low vapor pressure, it does not evaporate appreciably even at elevated temperatures.

Its principal services are steam, hot water, hot air, oxygen, high vacuum, also for dilute solutions of mineral acids (except nitric and hydrofluoric acid below 250 F); Hydrochloric acid, natural and synthetic rubbers, acetic acid, acetic anhydride and ethyl alcohol below 250 F. It is available only in soft bulk form for application by grease guns.

WELDED MAGNET RESISTS HEAT AND MOISTURE

▲ For general lifting magnet service, handling pig and scrap iron, slabs, castings and similar materials, The Electric Controller and Manufacturing Company of Cleveland, Ohio announces the type SW all-welded lifting magnet.



Radically different from previous construction, the type SW has its coil enclosed and hermetically sealed by continuous welds in a metal case. In the accompanying illustration, the magnet-housing has been cut away to show how this metal-encased coil is welded into the housing to provide a double seal against the entrance of moisture. Welds are continuous along the inner and outer circumferences of the coil-case and magnet-housing.

Inner and outer pole shoes are also welded in place to form a streamlined magnet with straight sides. There is no overhang to catch on sides of railroad cars and the elimination of recesses in the side of the magnet for bolt heads permits a magnet of full diameter throughout its depth. This allows a wider interior space, permitting a coil of greater diameter.

The coil-case after welding, is vacuum-treated and filled with a new (No. 282) compound which is then baked until it polymerizes to a stable condition. This new thermo-setting compound is resilient and clings to metal, has high dielectric strength, will not melt under heat (making it very desirable when handling hot materials) and will not become brittle.

The all-welded, water-tight construction of the type SW magnet permits its safe use in any service — in under-water salvage work — also, in cooling pits and other applications where moisture is excessive.

For better steel.. and more of it
this recorder of facts helps control STEEL QUALITY
YOU find Hays Series "OT" Pressure Recorders on many new and modernized open hearth installations—and for just one purpose: to make a permanent record of furnace performance. Guesswork is eliminated, man power saved, and rejects cut to the minimum.
On the 10-inch 24-hour charts you can have a record of two draft values, two pressure values, two differential values or any combination of two of those three values.
Here's a simple practical means to more effective control of steel quality. Better get the facts about it—send for Bulletin 43-586.
The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

FOR YOUR TOUGHEST MATERIALS HANDLING JOBS . . . SPECIFY THE NEW
PHILCO "THIRTY"
-with 30% Longer Life!
The tougher the jobs, the better this new Philco "Thirty" Storage Battery shows up. For long ramps and heavy loads — Philco "Thirty" delivers the power. And — in addition — it gives 30% longer life! Write today for the new Philco "Thirty" catalog.
The new Philco "Thirty" for electric industrial trucks is identified by its distinctive red connectors.
PHILCO CORPORATION
STORAGE BATTERY DIVISION
TRENTON 7, NEW JERSEY

TEMPERATURE OF MOLTEN METAL IN 45 SECONDS

▲ All patent rights to a new platinum thermocouple, providing practical and accurate results in measuring molten steel temperatures, have been acquired by the Brown Instrument Company, Philadelphia industrial instrument division of Minneapolis-Honeywell Regulator Company.

The rights, covering manufacture and sale, were acquired from the Rustless Iron and Steel Corporation.

The thermocouple, referred to in the metallurgical field as a revolutionary advance in steel processing, is described by Brown engineers as a device that when used in conjunction with a Brown ElectroniK recorder, measures within 45 seconds the temperature of molten steel even when the steel is covered with slag.

The thermocouple has two basic parts, an immersion head, comprising a platinum and platinum-rhodium thermocouple encased in a fused silica tube mounted in a block of graphite, and a handle which is a 12-ft insulated pipe containing wires leading to the Brown ElectroniK recorder.

In actual operation the immersion head is manipulated through the furnace door where it is dipped into the steel bath. The exposed tip of the silica tube, containing platinum thermocouple wires, is immersed in the steel itself. A rugged graphite block protects the sensitive silica tube against deterioration by slag, mechanical shock, etc.

The entire operation takes only 45 seconds. Temperature is recorded automatically on a recorder, designed expressly for this application. The recorder, customarily mounted near the furnace, within easy visibility, is one of the new ElectroniK series. It employs a large scale for distance reading. The chart rotates at the rate of one revolution in four minutes and only during reading.

Brown officials reported production of the new molten steel thermocouple is under way and deliveries may be expected in 90 to 120 days.

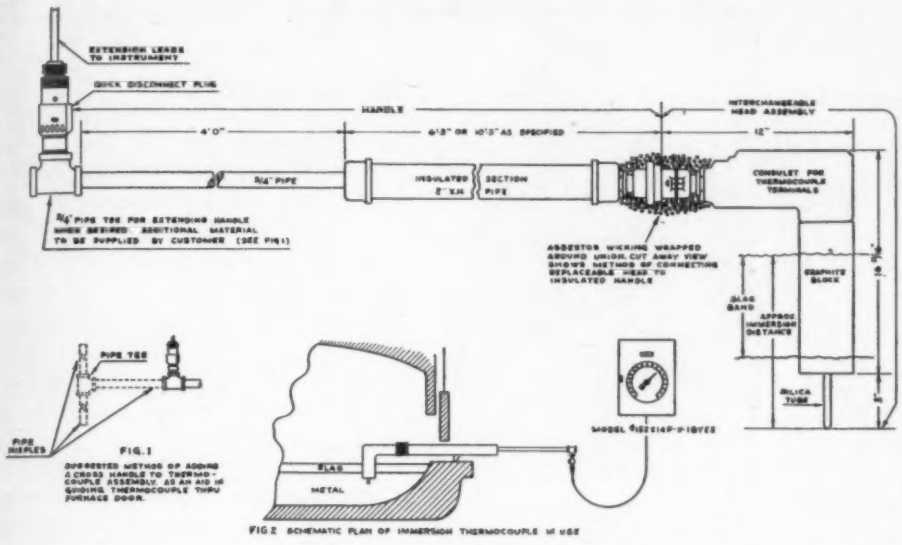


FIG. 1 SUGGESTED METHOD OF ADDING A CROSS HANDLE TO THERMOCOUPLE ASSEMBLY, AS AN AID IN GUIDING THERMOCOUPLE THRU FURNACE DOOR.

FIG. 2 SCHEMATIC PLAN OF IMMERSION THERMOCOUPLE IN USE

WESTINGHOUSE ACQUIRES STURTEVANT COMPANY

▲ Acquisition of the B. F. Sturtevant Company, of Boston, Massachusetts, pioneer in the design and manufacture of air handling and processing equipment, has been announced by A. W. Robertson, chairman of the Westinghouse Electric Corporation.

The Sturtevant Company becomes a wholly-owned Westinghouse subsidiary, operating as the B. F. Sturtevant Company, a division of Westinghouse Electric.

The Sturtevant Company's products cover a wide range in the fan and blower field, heating, cooling and air conditioning apparatus, including application and design of complete air handling and processing systems for industry, and acquisition of the Sturtevant Company is a step to meet postwar expansion in the air conditioning and related fields.

In addition to its main plant at Boston, the Sturtevant Company has other factories at Camden, New Jersey, La Salle, Illinois, Berkley, California, and Galt, Ontario, Canada. Offices and representatives are located in 42 cities in the United States and Canada.

Less Fuse Blowing with COOL FUSES

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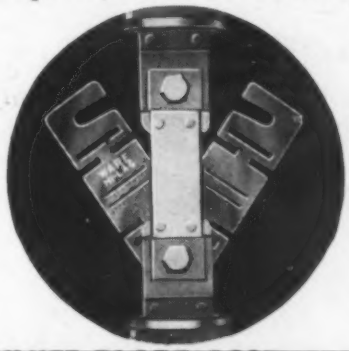
Keep Motors Humming



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And Quick Link Removal

100% Quality

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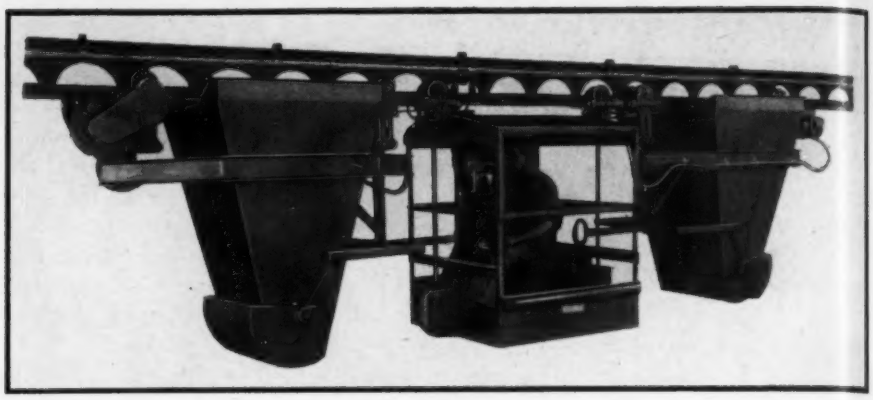
Renewable

HI-LAG FUSES

DOUBLE BUCKET CARRIER OPERATED FROM CAB



▲ A new motor-driven cab-operated double bucket carrier has been developed by The Cleveland Tramrail Division of The Cleveland Crane and Engineering Company, Wickliffe, Ohio, for the transportation of dry bulk materials.

The operation of the carrier and the opening and closing of the bucket gates are handled by the cab operator who sits on swivel chair enabling him to work in the direction of either bucket. A single variable speed drum controller is located on one side of the cab, but two foot brakes are provided, one at either end so that one is always in convenient reach of the operator regardless of which direction he is operating the carrier. Push-pull levers for opening the bucket gates extend into the cab and permit emptying the materials in any amounts and at any rate desired.

The unit illustrated has two 25 cu ft buckets and is designed for carrying a total load of two tons. Other size Cleveland Tramrail carriers can be supplied, however. The buckets are designed and located with reference to the tramrail arch beam rail, so that they may be easily filled from overhead bins without interference or spillage.

The carrier is provided with two motorized travel drives, one at each end, and operates at speeds up to 600 feet per minute.

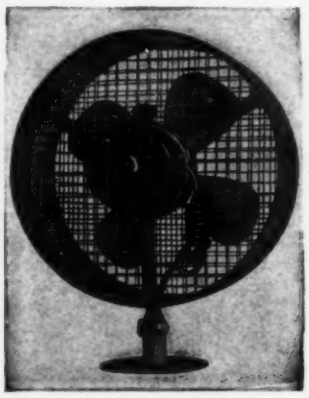
ALLOY ROD USED FOR WELDING CAST IRON

▲ EutecRod 14, a low melting alloy for the gas welding of cast iron was used to make a temporary repair on the connecting rod of a giant 75-ton punch press at the Jacksonville, Florida plant of the Moore Dry Kiln Company in March, 1942. This press with the temporary repair is still in operation. Three years have passed and the welded area has shown little sign of wear or deterioration. We feel this is conclusive proof that Eutectic low temperature welding alloys can be used with marked success on large complicated repair jobs.

EutecRod 14 offers:

1. A perfect color match to cast iron.
2. Is entirely machinable.

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep Them COOL with TRUFLO FANS

TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

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TRUFLO FAN COMPANY
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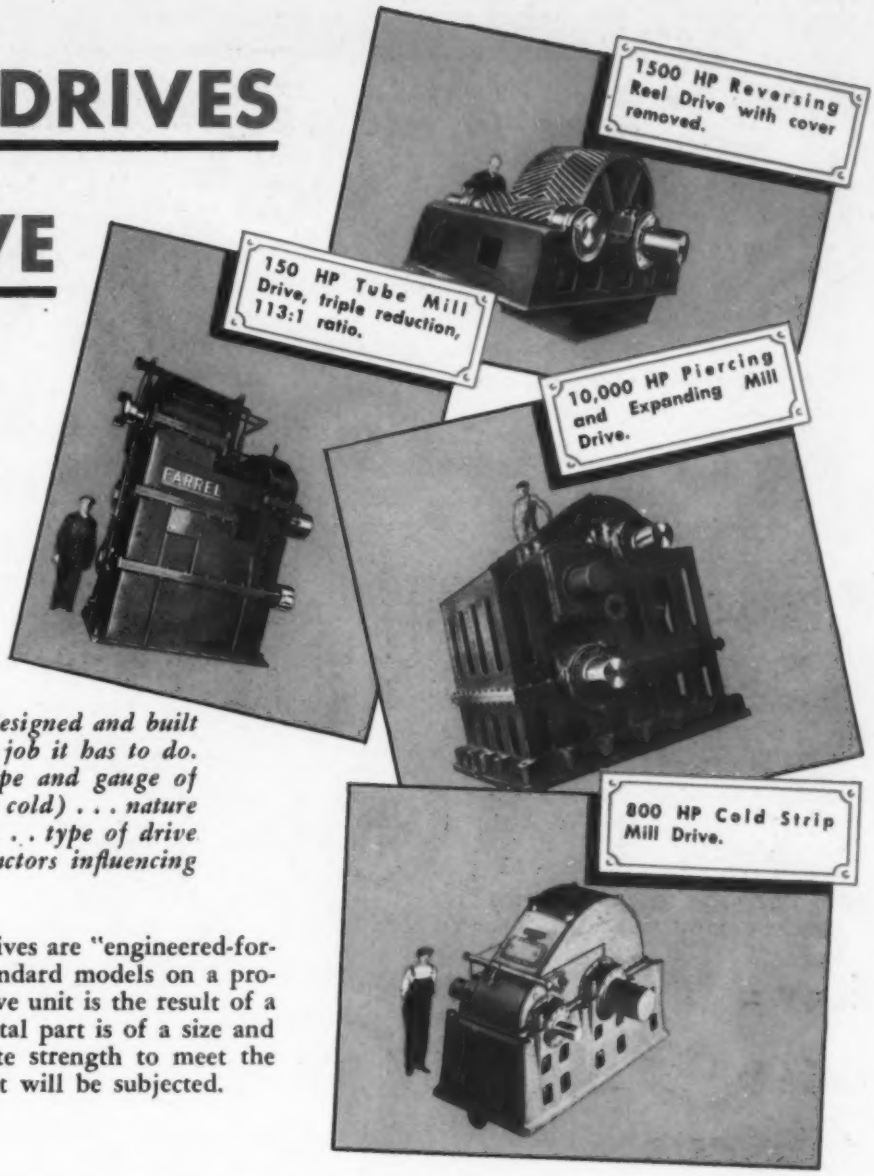
WHY MILL DRIVES DON'T HAVE MODEL NUMBERS


1500 HP Reversing Reel Drive with cover removed.
150 HP Tube Mill Drive, triple reduction, 113:1 ratio.
10,000 HP Piercing and Expanding Mill Drive.
800 HP Cold Strip Mill Drive.
FARREL

Each rolling mill drive must be designed and built to fit the specific requirements of the job it has to do. Power and speed to be used . . . type and gauge of metal to be rolled . . . process (hot or cold) . . . nature of load (continuous or intermittent) . . . type of drive motor . . . all these are important factors influencing mill drive specifications.

That's why Farrel-Birmingham mill drives are "engineered-for-the-job" instead of being made in standard models on a production line. This means that each drive unit is the result of a careful engineering study and every vital part is of a size and material which provides fully adequate strength to meet the stresses, strains and shocks to which it will be subjected.

FARREL ROLLING MILL MACHINERY

- Rolls
- Rolling Mills
- Rod Mill Tables and Manipulating Equipment
- Universal Mill Spindles
- Rod Coilers
- Gears
- Gear Drives of any Capacity
- Mill Pinions
- Pinion Stands
- Flexible Couplings
- Roll Grinding Machines
- Roll Calipers
- Lead Presses for Pipe or Rod

Housings are of cast steel, Meehanite or welded steel construction, with either double-walled or single-walled deep base, depending on requirements. They are proportioned to maintain accurate alignment of all shafts despite continued stress and strain.

The gears are usually continuous tooth herringbone — the famous Farrel-Sykes *Gear with a Backbone.* Backbone, the place where the teeth meet instead of being separated by a center groove, provides extra strength and load-carrying capacity. Other types of gears are furnished where required.

Bearings may be either babbitt-lined steel cartridges or any approved make of anti-friction bearing—always of adequate size for the job they have to do.

The precision ground shafts are designed to provide the rigidity necessary to prevent deflection and keep gears in exact alignment.

Dependent on conditions or requirements, lubrication may be by dip-and-splash system, by built-in pump driven by one of the shafts, or by a separate lubrication system.

Why not call on us when planning your next mill drive? Our engineers will be glad to discuss gear drive problems with you at any time without obligation.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

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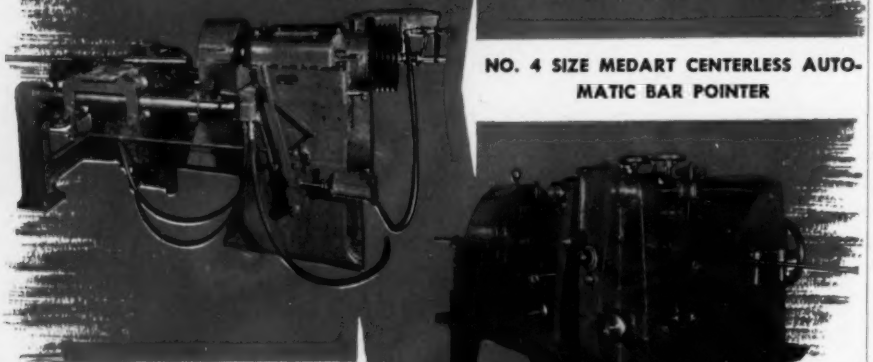
NO. 3 SIZE TYPE LS HEXAGON, FLAT AND SQUARE STRAIGHTENING MACHINE



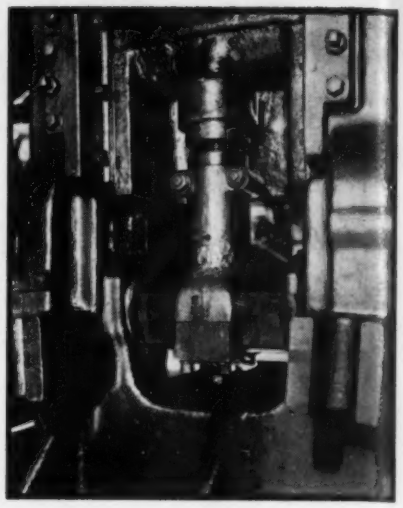
NO. 4 SIZE MEDART CENTERLESS AUTOMATIC BAR POINTER

No. 0A SIZE MEDART TWO ROLL SINGLE MOTOR ROTARY STRAIGHTENING, SIZING AND POLISHING MACHINE

EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY



View showing connecting rod of 75-ton punch press which was repaired by low temperature welding.

3. Matches the base metal in corrosion and heat resistance.
4. Offers a weld metal strength of 48,000 psi. It is a cast iron rod specially coated with Eutectofilm to protect it against corrosion and at the same time improve its welding properties.

The following procedure was used in welding the fracture: The fractured edges were beveled to form a 90 degree "vee" with a sufficient amount of metal at left the bottom of the groove to provide accurate alignment.

Little preheating was required because of the simple shape of the casting. After warming the casting to approximately 300 F, the heat of the oxyacetylene torch was concentrated on the joint where Eutector Flux 14 had been applied. The weld was accomplished when the weld area reached a temperature of 950-1400 F, well below the melting point of the parent metal.

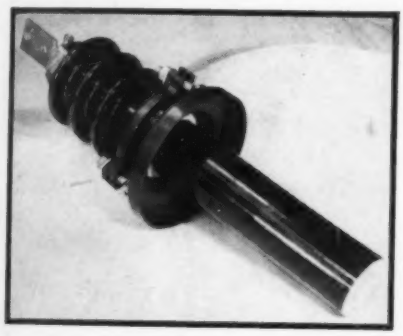
When the welded connecting rod was put back on the press, it was expected that the bearing surfaces would have to be machined before the press could be operated. However, the two bearings were parallel and each end held so close to the original alignment that it took only a few minutes to scrap the rod and put the press back in operation.

The accompanying illustration shows the welded connecting rod on the 75-ton punch press. This rod works at 90 strokes per minute. In spite of this heavy duty work the welded part has stood up. Proof again that no repair job is too large or too small for Eutectic low temperature welding alloys.

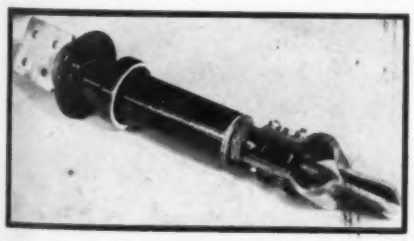
CLAMPING ELIMINATES CEMENT IN BUSHINGS

▲ All joints between porcelain and metal parts are sealed by clamping without the use of cement, which assures oil-tight and gas-tight joints, in two new transformer bushings announced by Pennsylvania Transformer Company.

The heavy current bushing with voltage ratings of 5000 and 15,000 volts and current ratings from 500 to 3000 amperes, has on the lower end of the bushing conductor, a laminated connector which is attached to the transformer leads. Being flexible, this connector eliminates stress on the insulator caused by thermal expansion of the transformer lead. Heavy alloy bolts are used throughout for electrical and mechanical connections. Mounting the bushings in a nonmagnetic slot cover eliminates unnecessary losses and heating. Nonmagnetic clamps attach the bushing to the cover.

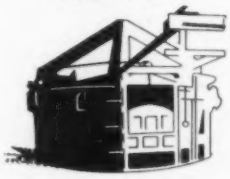


Cementless transformer bushings, bolted to casing by a split flange, are sealed oil-tight and gas-tight by a gasket.

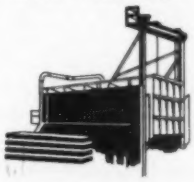


The power bushing rating is 7500, 15,000 and 25,000 volts with a current rating of 440 amperes. The cable lead from the transformer winding is brazed to a stud which issues through the insulator in a manner that prevents it from turning when the hardware is attached. Electrical and mechanical connections between the stud and the hardware at the top of the porcelain are made by a cap nut

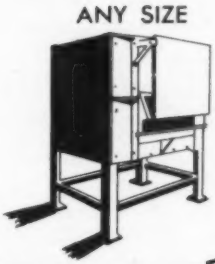
ANY TYPE



ANY PURPOSE



ANY SIZE



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GIVE LONGER, TROUBLE-FREE SERVICE!

DOUBLE-SHIELDED BALL BEARING
SHIELDS PROTECT BEARING AGAINST OVER-LUBRICATION KEEP GREASE IN, DIRT OUT
GREASE SEAL AGAINST MOISTURE AND DIRT
NO LEAKAGE OF GREASE INSIDE OF MOTOR
CLEARANCE FOR ELIMINATION OF EXCESS GREASE
CROSS-SECTION OF DOUBLE-SHIELDED BEARING IN HOUSING

A BALANCED DESIGN, PRECISION BUILT

1. **Protecting enclosures** keep out dirt, chips, oil, excess moisture.
2. **Steel stators for strength,** incorporating experience from building motors to meet Navy high shock requirements.
3. **Thirteen-step winding treatment,** for maximum stator protection.
4. **Pressure cast rotors** provide trouble-free aluminum windings.
5. **Heavy shafts,** liberally designed for added strength.
6. **Improved bearing lubrication** affords *real* protection to bearings and windings.
7. **Optional lead outlet arrangement** permits machine mounting with elimination of conduit box.
8. **Flange and face type brackets** offer alternative methods of machine application.

HERE'S good news for users of electric motors! No special lubrication attention is necessary with Reliance Series C Motors.

Just follow whatever greasing practice you have established for ball bearing motors. Properly lubricated, over-greased or under-greased, the Reliance design provides the answer to securing longer bearing life.

If under-lubricated after installation, bearings with this design will last longer than non-shielded bearings given the same treatment. This is because of grease retained within the shields plus grease remaining in the housing from its initial filling.

If over-greased after installation, they will operate satisfactorily without overheating, whereas non-shielded bearings under the same treatment may fail.

It is not necessary to disassemble motors at the end of fixed periods to grease bearings. Bearing shields do not require renewal.

Simplified lubrication procedure and longer life are good reasons for preferring Reliance A-c. and D-c. Motors. Some of the other reasons are indicated at the left. Write to or call the nearest Reliance office for complete information.

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Send for Instruction Sheet 3042, which tells about Reliance double-shielded bearing design and why it needs no special attention. Information worth having, and it's yours for the asking.

RELIANCE A-C D-C MOTORS

tightened against the porcelain through a cork gasket, and a terminal cap on the same stud, tightened against the cap nut. This metal to metal contact assures permanent pressure on the threads of the stud and provides a positive high pressure and low resistance contact. Either a spade-type terminal for bus connection, or a cable clamp-type terminal may be used. Both types are interchangeable.

Bushings are bolted to the mounting casing by means of a split flange which rests on the top of the porcelain shoulder. Between the shoulder and the transformer cover, there is a gasket which provides an oil and gas tight seal.

WATER CONFERENCE TO BE HELD IN PITTSBURGH

▲ The Sixth Annual Water Conference of the Engineers Society of Western Pennsylvania, scheduled for October 22 and 23 in Pittsburgh, Pennsylvania, will be held as a district meeting in conjunction with the Civil Section of the society. The program lists a total of ten papers covering a wide range of topics dealing with water supply and treatment. Sessions are scheduled for the morning and afternoon of both days. H. M. Olson is general chairman.

REMOVABLE MOUNTINGS FOR SMALL CAPACITORS

▲ Small capacitors are now available with new removable mounting brackets, according to General Electric's Transformer Division, Pittsfield, Massachusetts. These brackets can be obtained with all small, rectangular-case capacitors for use in either a-c or d-c applications, and can be clamped over either the top or bottom flange of the case thus permitting the unit to be mounted in an upright or inverted position.

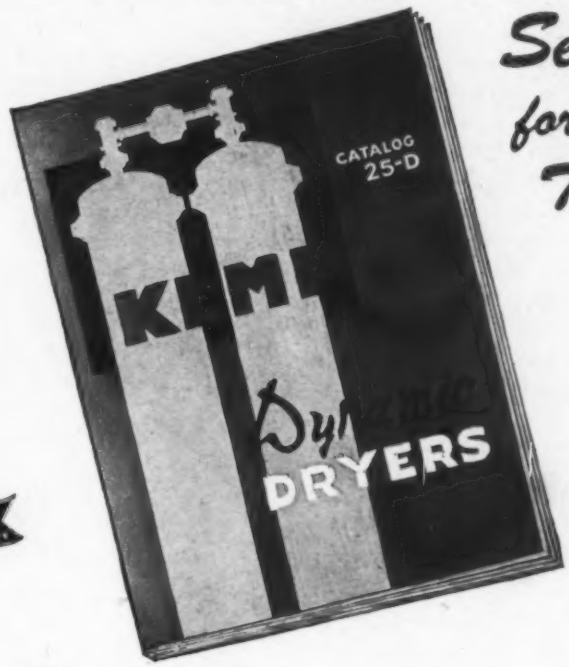
These removable brackets have a U-shaped foot with a reverse bend which projects under the mounting surface of the capacitor. The mounting foot is sufficiently flexible to compensate for normal tolerances in the case heights, and allows the brackets to be firmly clamped to the unit when mounted.

The brackets are accurately die-formed from steel punchings, and they have a durable, corrosion-resistant finish of lacquered zinc plate, which provides an adequate ground from unit to chassis. Small, narrow capacitors have brackets with a single mounting hole, but where the width of the case permits, a wider bracket with two mounting holes is used.

PORTABLE ELECTRIC UNIT FOR TEMPORARY HEATING

▲ Because there are many locations where heat is required only at certain periods, investment in stationary permanently-installed unit heaters does not seem warranted. For such purposes and for supplying heat at any of many locations or extra amounts occasionally, Electric Air Heater Company of Mishawaka, Indiana, has been supplying new portable model heaters, designed originally for the heating of emergency huts used to protect men working outdoors in a steel plant. Heater elements, fan motor, contactor and switch are all mounted on one base provided with castors for easy mobility.

Send for it Today!



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Just off the press—this 44-page bulletin is a real contribution to engineering literature and should be in your files. It is an authoritative, well-illustrated treatise which makes clear (a) the mechanics of operation of dynamic adsorptive dehydrators (b) the characteristics which make solid adsorptive dessicants so efficient for the dehydration of air or gases, the drying of liquids, and for industrial control.

A wide variety of both standard and special units is also shown to illustrate how KEMP Dynamic Dryers can be profitably applied to your operations and processes.

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Nitrogen Generators • Inert Gas Producers
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New Literature

▲ The "skin recovery" or carbon restoration process by the use of a controlled gas atmosphere is described in new bulletin No. SC-125 just issued by Surface Combustion Corporation, Toledo 1, Ohio. Application of the process in preventing decarburization of various steels and how it differs from the process of carburization is also covered.

Applicable to both carbon and alloy steels, the bulletin brings out the desired value of maintaining the carbon content of the surface of the material in preventing reduction of its endurance limit under repeated stresses and in often eliminating the need for machining operations subsequent to heat treatment. Various photomicrographs indicate the effect of the process on several types of steels. Charts showing the unbalanced carbon concentration from surface to core metal obtained by the carburizing process and the balanced condition when the skin recovery process is used, are also included.

To illustrate the difference between normal heat treatment and skin recovery process, a chart of Vickers micro-hardness for depths up to 0.050 in. for both treatments is shown. Carbon content of the original material is maintained within 0.03 per cent by the latter process.

Since the principal requirement in applying the process is that the work be heated in a chamber wherein both air and flue gases can be completely excluded, illustrations of Surface Combustion furnaces of both batch and continuous type in which this requirement is met, are also included.

▲ The Meehanite Research Institute, Pershing Square Building, New Rochelle, New York, has published a bulletin on the subject of "Pressure Castings." The folder describes a variety of pressure applications and illustrates faulty and correct design for pressure units. Other Meehanite literature which is also available is described. A copy will be mailed upon request.

▲ Bailey Meter Company, Cleveland 10, Ohio, has published bulletin No. 62 featuring Bailey open channel meters for sewage industrial wastes, sludge, and irrigation water. The meters described in this bulletin are of both the direct mechanical and the electronic telemeter type. A wide selection of registers having various combinations of indicating, recording and integrating features is illustrated. Alternate methods for mounting registers on wall, panel and pedestal are also shown.

All types of registers are said to be suitable for use with flumes, weirs, and atmospheric discharge nozzles. Outstanding features claimed are low cost, easy installation, self-cleaning, the availability of automatic control, and suitability for use in flow totalizing systems.

▲ A 170-page, pocket-size catalogue and manual, entitled "The Tool Steels of Allegheny Ludlum," has just been released for distribution by the Allegheny Ludlum Steel Corporation Brackenridge, Pennsylvania.

Double the size of preceding edi-, tions, the manual provides a complete and straight-forward coverage of tool steels for all uses and users. It contains many pages of technical data and is liberally illustrated. Thumb-indexing and sectional arrangement, plus a full general alphabetical index, make it easy to use. Copies may be had by writing the Allegheny Ludlum Steel Corporation, Brackenridge, Pennsylvania.

▲ The Torrington Company, Torrington, Connecticut, and South Bend, Indiana, announces the publication of a new 153-page manual — a combined catalog and engineering and application data reference volume for designers and engineers. Entitled "Torrington Needle Bearings" and listed as edition No. 32, it supplies all pertinent engineering information on the various needle bearings identified as types LN, DC, NCS, AT and RC.

A separate section on application data, profusely illustrated with cross-section drawings, shows a wide variety of uses in equipment of aircraft, automotive, farm equipment, machine tool, material handling petroleum, power, steel, textile, and miscellaneous industries.

Included in the informatory data are specifications and tolerances; load capacities; design factors; installation and inspection data; various standards, and a wealth of similar material. The manual is fully indexed for handy reference and has many tables, formulae and illustrations that clarify the technical data and serve as a valuable guide for the engineer and production executive. Copy of the new catalog No. 32 will be sent on request.

▲ Three grades of "Long-Lyfe" blast nozzles are cataloged and priced in a new 12-page illustrated booklet just published by American Foundry Equipment Company, 500 South Byrkit Street, Mishawaka, Indiana.

Included are the following nozzles: (1) American-Norbide, guaranteed for 1500 hours using steel abrasive; (2) American-Heanium, having a long-wearing ceramic insert; and (3) American V-Metal, made of heat-treated abrasion-resisting alloy steel.

A copy of this new publication will be mailed to any interested plant by asking the manufacturer for catalog No. 27.

▲ Extensive data on the corrosion rates of cast iron exposed to the action of substances commonly handled by chemical structures feature a pamphlet, entitled "Cast Iron in the Chemical and Process Industries," recently published by the Gray Iron Founders' Society, national association of manufacturers of engineering gray irons. It is the work of F. L. LaQue, head of the corrosion engineering section of the International Nickel Company, Inc.

Results of laboratory and plant tests with more than 300 corrosive media in an alphabetical range from acetic acid to zinc sulfate are shown. The four appended tables also list the many chemicals regularly handled by cast iron pumps and valves and those resisted satisfactorily by high silicon irons.

Factors dictating cast irons for corrosive service, the availability of the material, design for chemical industry equipment and many specific applications are discussed in the text of the 28-page publication.

The pamphlet is available at $1 per copy from the society's Cleveland or Washington offices.

▲ A new folder just released describes a group of alloys developed by Callite Tungsten Corporation under the name of Callinite which are made by the powder metallurgical process.

Callinite is a high conductivity facing material for high current applications where pitting, sticking or welding of contacts may occur. It is also suitable for facing arcing tips on air circuit breakers, heavy duty circuit

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with **AX5's or SA35's**

GO INTO any steel mill today. You'll see excellent mill motors like these . . . giving unprecedented round-the-clock service!

In more and more of such heavy-duty motors, "National" Grade AX5 or Grade SA35 brushes are being installed. Operating men have learned that both of these electro-graphitic brush grades are *strong mechanically* . . . have superior commutating characteristics . . . combine high contact drop with low coefficient of friction . . . and are non-abrasive!

Both grades were developed after thorough studies of load and atmospheric conditions, commutator maintenance problems and many other practical, steel-mill operating factors.

They are but two of a number of carbon, graphite, electro-graphitic and metal-graphite brush grades that National Carbon Company, Inc., has developed to meet the varying needs of every class of rotating electrical equipment . . . from fractional horsepower motors to the largest motors and generators.

The word "National" is a registered trade-mark of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

General Offices: 30 East 42nd Street, New York 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

breakers, motor controllers, heavy duty relays, industrial control contacts.

Bulletin No. 158 describes the various types of Callinite: Type TC, a tungsten-copper alloy, Type ST, a tungsten-silver alloy. Each of these types is available in three grades for specific applications as described in detail in the new folder. Callinite alloys are available in rods, squares and rectangles, and inserts. Copies of the folder which describes Callinite alloys in detail are available on request to Callite Tungsten Corporation, 540 Thirty-ninth Street, Union City, New Jersey.

▲ A new catalog issued by Shook Bronze Corporation is devoted to ready-to-use bushings and machined bronze bars made of a special phosphorized bearing bronze, for which important special advantages are claimed.

This special alloy, Shook 664 phosphor bronze, is cast by a new method known as radial grain control which reduces matrix size and causes the grain structure to flow toward the center of cylindrical castings from outer circumferences.

The catalog lists over 800 stock sizes of machined bushings of this new bronze. as well as over 400 stock sizes of precision-machined bored and solid bronze bars.

Another page in the catalog is devoted to babbitt metals made by this manufacturer and supplied in silver-treated, cadmium-treated and cadmium-nickel-treated types.

Copies of this catalog may be obtained by writing to Shook Bronze Corporation, Lima, Ohio, requesting catalog No. 45.

▲ An 8-page bulletin, No. 83-C, entitled "Bailey Thermo-Hydraulic Feed Water Regulators" has been issued by Bailey Meter Company, Cleveland 10, Ohio. It describes and illustrates improved designs of thermo-hydraulic generators and bellows operated feed water regulator vWlve suitable for feed lines ranging in size from ¾ in. to 6 in. inclusive.

A full page colored schematic illustration demonstrates the thermo-hydraulic principle which is entirely self-contained requiring no outside source of power.

▲ Corrosion is one of the most destructive forces of nature and water when heated to relatively high temperature may cause severe corrosion and deterioration of steel pipelines, equipments, etc.

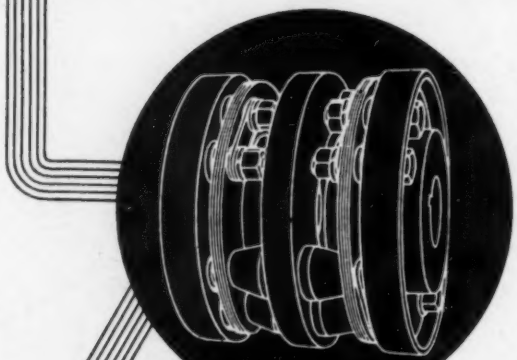
Cochrane Corporation, Philadelphia 32, Pennsylvania, has developed a deaerator for the purpose of removing oxygen and carbon dioxide from process waters used cold. This removal of oxygen and carbon dioxide will prevent corrosive action and thus give protection to equipments, eliminating maintenance and absolescence.

The manner in which this is accomplished is described in Cochrane reprint 43, "Cold Water Deaeration,' which is free for the asking.

▲ Eastern Stainless Steel Corporation of Baltimore has ready for distribution a complete 96-page handbook, "Eastern Stainless Steel Sheets." The first 34 pages of the new Eastern Stainless catalog are devoted to a pictorial review of the importance of stainless steel in various industries.

There is an informative section entitled, "Why Stainless Steel Resists Corrosion." At least a page is devoted to each Eastern Stainless grade of stainless, with appropriate applications of each type. One of the most

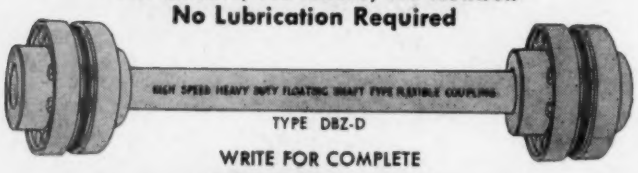
THOMAS
Flexible COUPLINGS



TYPE DBZ
TYPE DSM
TYPE CM
TYPE AM
TYPE-MT
TYPE SS

"Eliminate BACKLASH, FRICTION, WEAR AND CROSS-PULL
the four destructive evils of other types and makes of couplings that prevent a permanent care-free installation.

The Thomas All-Metal Coupling has:
No Chains, No Gears, No Rubber.
No Lubrication Required



TYPE DBZ-D

WRITE FOR COMPLETE ENGINEERING CATALOG

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

interesting and valuable features of the new Eastern Stainless catalog is a 4-page "turn-out" spread giving complete details on properties of Eastern Stainless Steels.

Copies are available upon request ..astern Stainless Steel Corporation, Baltimore 3, Maryland.

▲ A new 12-page booklet titled "Engineering-Design Development of X-Ray Spectrometer" has been announced by North American Philips Company, Inc., 100 East 42nd Street, New York.

The text material was written by J. S. Buhler, technical-commercial manager, and covers in detail the basic design principles involved in the Geiger-Counter X-ray spectrometer, a recently developed industrial control tool.

Specifically, the author discusses: X-ray diffraction principles, new instrument requirements, X-ray source, pulse conditioning, frequency meter circuit, Counting meter circuit, meters and controls, and applications.

Amply illustrated with drawings and photos, the new booklet should be a valuable addition to the industrialist's library.

▲ Two new bulletins presenting the latest improved lines of multiple punches and spacing tables, and describing their operations, are announced by Thomas Machine Manufacturing Company, Pittsburgh 23, Pennsylvania.

Bulletin 306, entitled "Thomas Multiple Punches and Spacing Tables" contains 25 large illustrations in its 16 pages with condensed descriptions of multiple punches and tables. Tool set-ups for punching plates and shapes on a number of these machines are pictured. Spacing tables illustrated include the completely automatic, semi-automatic, hand-operated and indicator types.

Punches in six sizes, from 150 tons to 1,000 tons, designed for punching plates and all classes of structural material, are shown, together with spacing tables designed for a variety of applications in the railroad car shop, structural shop and similar industries. A table of punching capacities is given.

The companion Bulletin 306A, entitled "The Thomas Spacing Table in the Structural Shop," four pages with five illustrations, describes the mechanics of the spacing table acting with multiple punch. Methods of operation for various purposes are thoroughly discussed, as well as the advantages that are obtained over hand layout and punching.

▲ A new 4 page leaflet describing "X-Ray Diffraction — An Industrial Tool," has been announced by North American Philips Company, Inc., 100 East 42nd Street, New York.

It explains the technique employed in Norelco film-type X-ray equipment for identification of materials. Simple sketches representing typical diffraction films are exhibited in order to show how comparisons are made.

The following industrial applications for X-ray diffraction are listed: 1. Establishment of identities in ceramic clays, 2. Checking ingredients of dairy products, 3. Quality tests on soapstone before firing, 4. Determination of covering quality of paint pigments, 5. Differentiation of natural and artificial pearls, 6. Identifica, 7. of aluminum oxide modifications, 8. Differentiation of inorganic fibers of Metallic deposition in formation of metallic carbides. 9. Determination of character of metallic films.

There are Switch and Circuit Breaker

CONDULETS

CONDULETS are made only by CROUSE-HINDS

to meet your every need.

The illustrations show a representative selection from the hundreds of different switch and circuit breaker CONDULETS—each designed for its special purpose, to help you do the job and do it right.

No. 2

of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.

Complete listings of each type are in Condulet Catalog No. 2500 or in supplementary bulletins.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY

Syracuse 1, N. Y., U.S.A.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. Resident Product Engineers: Albany — Atlanta — Charlotte

CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant, TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

KATHANODE
Glassklad since 1925

First American battery to use glass protection, Kathanode has had twenty years of unqualified success in powering electric industrial trucks. Behind it are two decades of constructive research—research that has developed:

Kathanode grid, exposing a minimum of surface area yet with ample cross-section for electrical conductivity.

Black Oxide, the unique active material with the regenerative pure lead core.

Spun glass mat, of exclusive layered design that positively retains useful active material.

Unit-Seal envelope, with open ends and solid edges to prevent treeing of spent material.

Durapor separator, of deeply ribbed and highly porous rubber construction, with great mechanical strength.

This research is constant; so look to Gould for leadership in storage battery developments.

Add Kathanode, the best battery power for propulsion and lifting, to the advantages of electric industrial trucks. Write Dept. 49 for Catalog 100 on Kathanode Glassklad Batteries for Industrial Truck and Tractor Service.

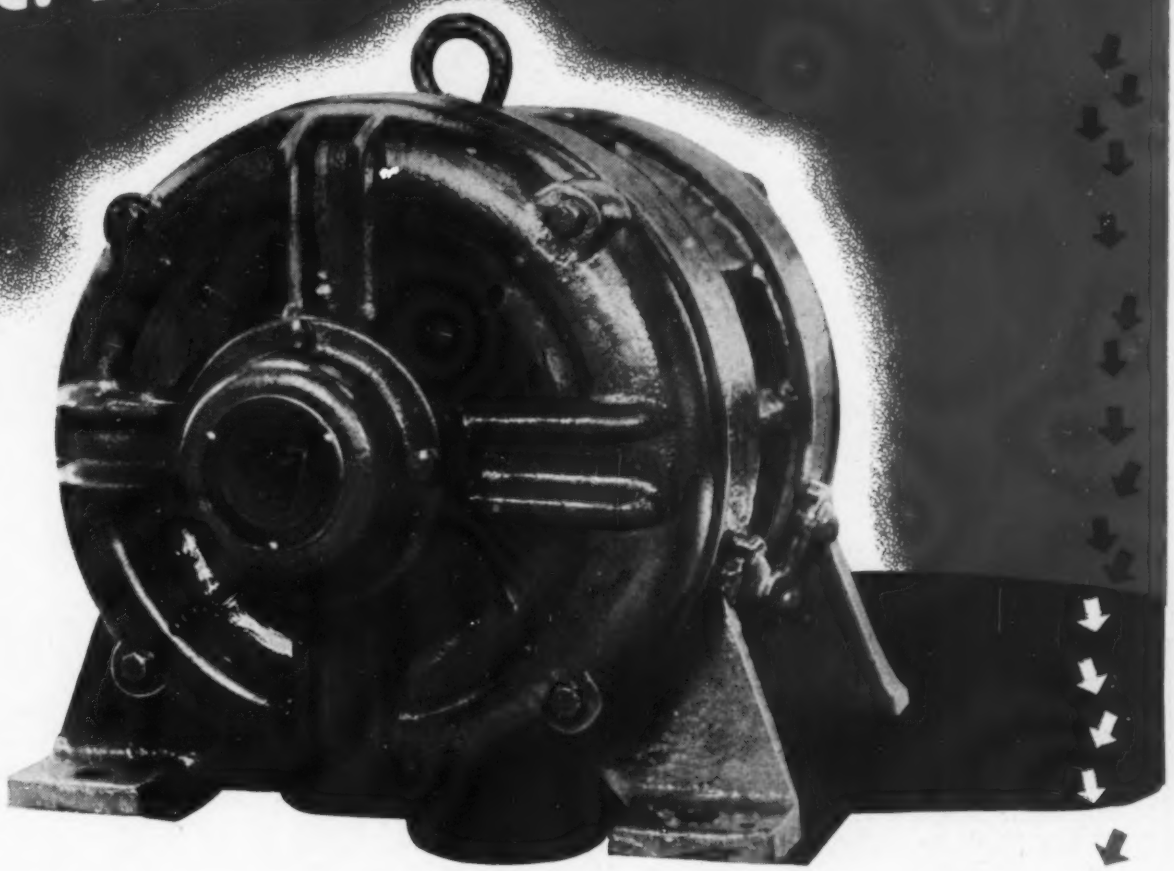
GOULD

PIONEER OF GLASSKLAD CONSTRUCTION

GOULD STORAGE BATTERY CORPORATION

Depew, N. Y. Factories: Atlanta • Chicago • Dallas • Depew • Leavenworth • Los Angeles • Napa Sonoma • Rock Island • St. Paul • Sioux City • Zanesville

WHEN THE ROTOR RUBS THE STATOR YOUR A. C. MOTOR IS BURNED UP.



KEYSTONE BALL BEARING END BELLS . . . . . .

Solve this problem

Naturally when your A.C. motor was new the air gap between the rotor and the stator was equal on all sides. As that motor is used, the gap becomes smaller at the bottom and larger at the top. And as the bearing continues to wear, only one result is possible . . . the rotor finally hits the stationary iron and all winding is immediately destroyed by the heat generated.

To help you avoid this trouble . . . to save maintenance costs and expensive re-winding of burnt-out motors . . . the Keystone End Bell was designed. It converts a sleeve bearing motor into a ball bearing installation and is so engineered that the ball bearings are destroyed long before the rotor and the stator rub.

Call or write us for complete information on both A.C. and D.C. Keystone designs.

Bearing Specialists

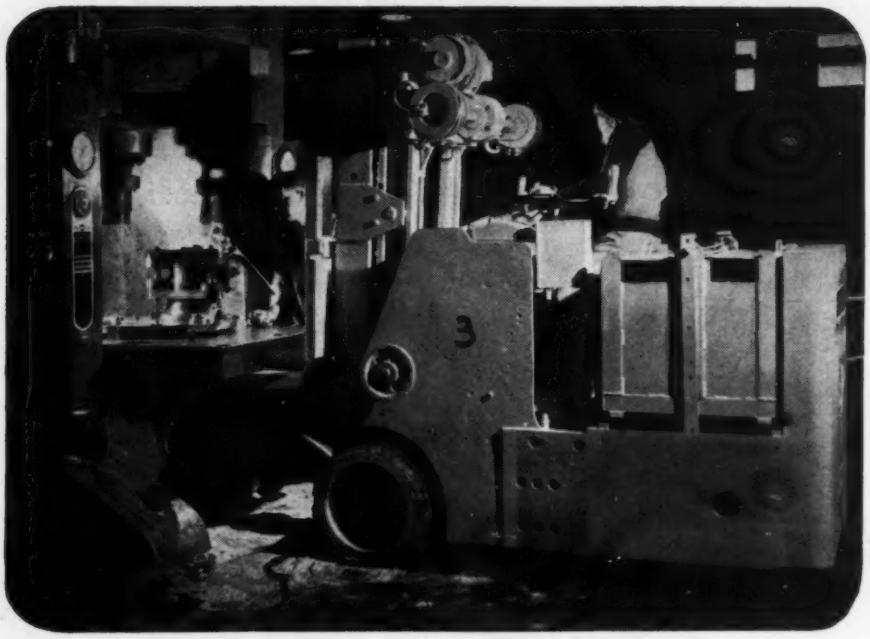
The OHIO BALL BEARING CO.

BALL-ROLLER and THRUST BEARINGS

HE 6643 6531-33 BOSTON AVENUE • CLEVELAND 3, OHIO

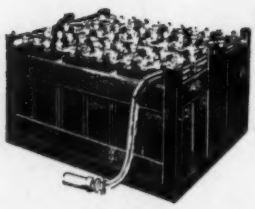
BRANCH OFFICES: Canton, Dayton, Columbus, Akron, Cincinnati, Youngstown, Charleston, Wheeling, Fort Wayne, Indianapolis, Lafayette, Muncie, Terre Haute

Use BATTERY TRUCKS *for* SPEEDY SET-UPS



Changing the punch on the ram of this press is simplified by use of a fork-lift truck. New developments in handling methods appear regularly in STORAGE BATTERY POWER. Write for a sample copy if you do not already receive it.

...ALKALINE BATTERIES *for 24-HOUR POWER*



In Industrial Trucks, Alkaline Batteries Give You These Important Advantages

- They are **durable mechanically;** grids, containers and other structural parts of the cells are of steel; the alkaline electrolyte is a preservative of steel.
- They can be **charged rapidly;** gassing cannot dislodge the active materials.
- They **withstand temperature extremes;** are free from freezing hazard; are easily ventilated for rapid cooling.
- They are **foolproof electrically;** are not injured by short circuiting, reverse charging or similar accidents.
- They can **stand idle indefinitely** without injury. Merely discharge, short-circuit, and store in a clean, dry place.
- They are **simple and easy to maintain.**

CHANGING large, heavy dies on huge production presses is one of the many handling operations that are being speeded up in numerous plants by means of battery industrial trucks. They enable one man to do the job of several in much less time, thereby increasing production efficiency of the presses. Further economies are effected by using the same trucks for storing idle dies in space-saving tiered racks.

A battery industrial truck has natural advantages for simplifying such handling jobs because of its superior maneuverability, high availability and dependable operation. Exchange batteries keep the truck continuously supplied with power. While one battery operates the truck, another is being charged. Except for the few minutes needed to exchange batteries, the truck need not stop for servicing its power unit. Its electric motor drives have a minimum of wearing parts; are inherently simple and trouble-free. The truck starts instantly; accelerates smoothly; operates quickly; gives off no fumes; consumes no power during stops. Not only does it make efficient use of power but the current used for battery charging is the lowest-cost power available.

Altogether, the battery industrial truck is one of the most dependable and economical types of handling equipment—especially when powered by Edison Alkaline Batteries. With steel cell construction, a solution that is a preservative of steel, and a fool-proof electrochemical principle of operation, they are the most durable, longest lived and most trouble-free of all batteries. *Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, N. J.*

Edison
ALKALINE BATTERIES

A SINGLE OBJECTIVE.....

Production Control

A SINGLE RESPONSIBILITY IN ACHIEVING IT

Higher tonnage and uniform quality of product result from efficient control of steel mill equipment. An invaluable aid in achieving this is a system of automatic controls and instruments that allows operators to concentrate on the factors making for optimum production. To secure these results, Republic Flow Meters Co. offers a complete manufacturing and engineering service—a single responsibility—in the field of measurement and control. We will gladly co-operate with you in the solution of any metering or control problem. Your inquiries involve no obligation.

FURNACE CONTROLS
For furnace pressure, fuel, fuel-air ratio.

BOILER CONTROLS
For all boilers, all types of firing.

REGULATORS
For pressure, flow, speed, level, ratio.

GAS MIXER CONTROLS
For mixing gases in desired ratio.

COKE OVEN GAS CONTROLS
For collecting mains, stack draft, pressures.

RING-BALANCE METERS
For steam, water, gas, air, oil, etc.

ELECTRICAL FLOW METERS
For steam, water, gas, air, oil, etc.

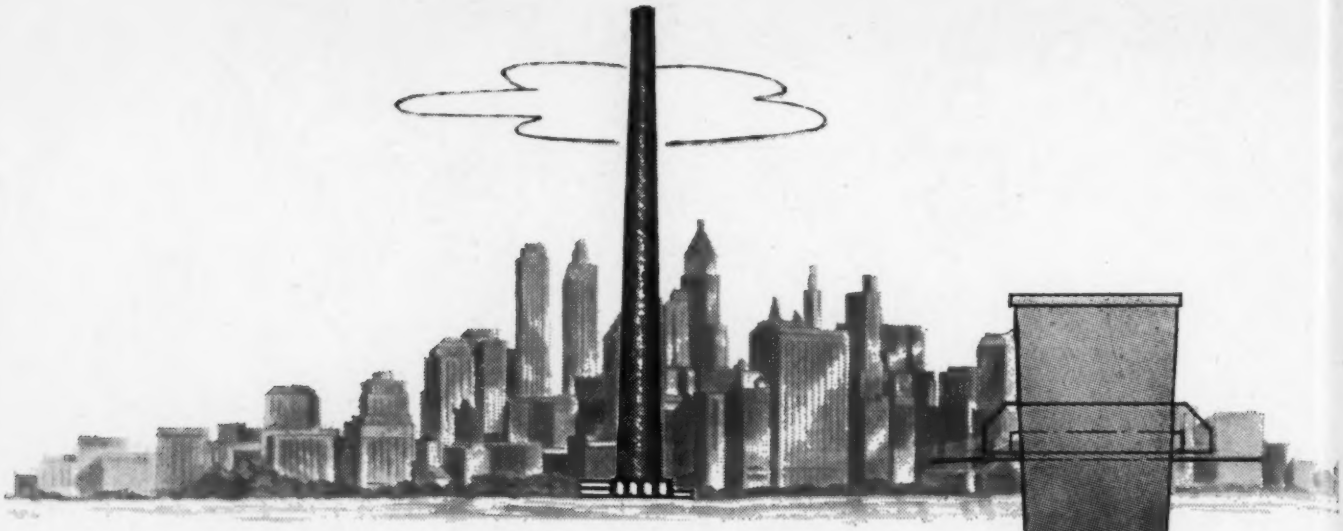
FURNACE PRESSURE RECORDERS
For pressure in all types of furnaces.

DRAFT & PRESSURE INDICATORS
For draft, pressure, flow, temperature, CO_2, etc.

THERMOMETERS
For temperatures up to 1000 F.

DATA BOOKS MAILED ON REQUEST

REPUBLIC FLOW METERS CO.
2220 Diversey Parkway, Chicago, Illinois

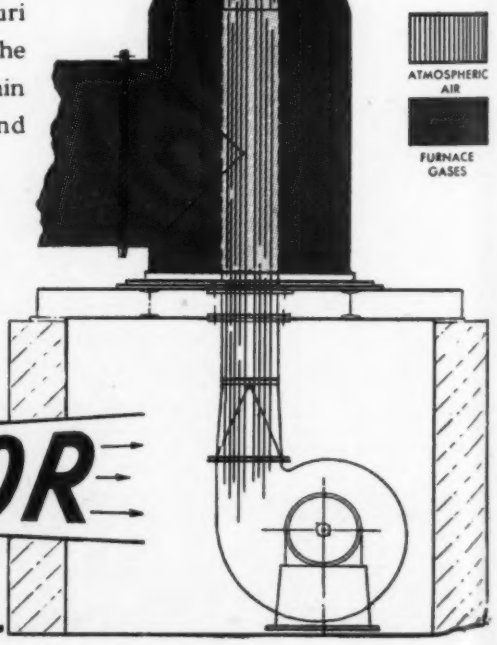


To *make sure* of dependable draft . . . it's more practical and economical to install a Morgan Airjector!

A stack a mile high *might* do the work of a Morgan Air*jector* 24 feet high, but in order to qualify in every respect the stack would be called upon to:

1. Provide a constant, positive exhaust, instantly adjustable for any required pull or draft. Air*jector* does it.
2. Provide a draft unaffected by weather, stack temperature, temperature of the gases or action of furnaces in the line. Air*jector* does it.
3. Use a *small* foundation — also a relatively small amount of steel — and require a minimum of maintenance. Air*jector* does it.

Morgan Air*jector* employs a fan located outside of the gas stream, and handling cool air only. This air passes through a nozzle within the venturi throat of a short steel stack, forming a powerful suction which pulls the gases throughout the system, mixes these gases with the cool air within the stack, and discharges to atmosphere at reduced temperature and lowered luminosity.



AVAILABLE NOW: You can figure on prompt service in all cases when the moderate amount of steel will be made available. Our engineers are ready to consult with you.

MORGAN

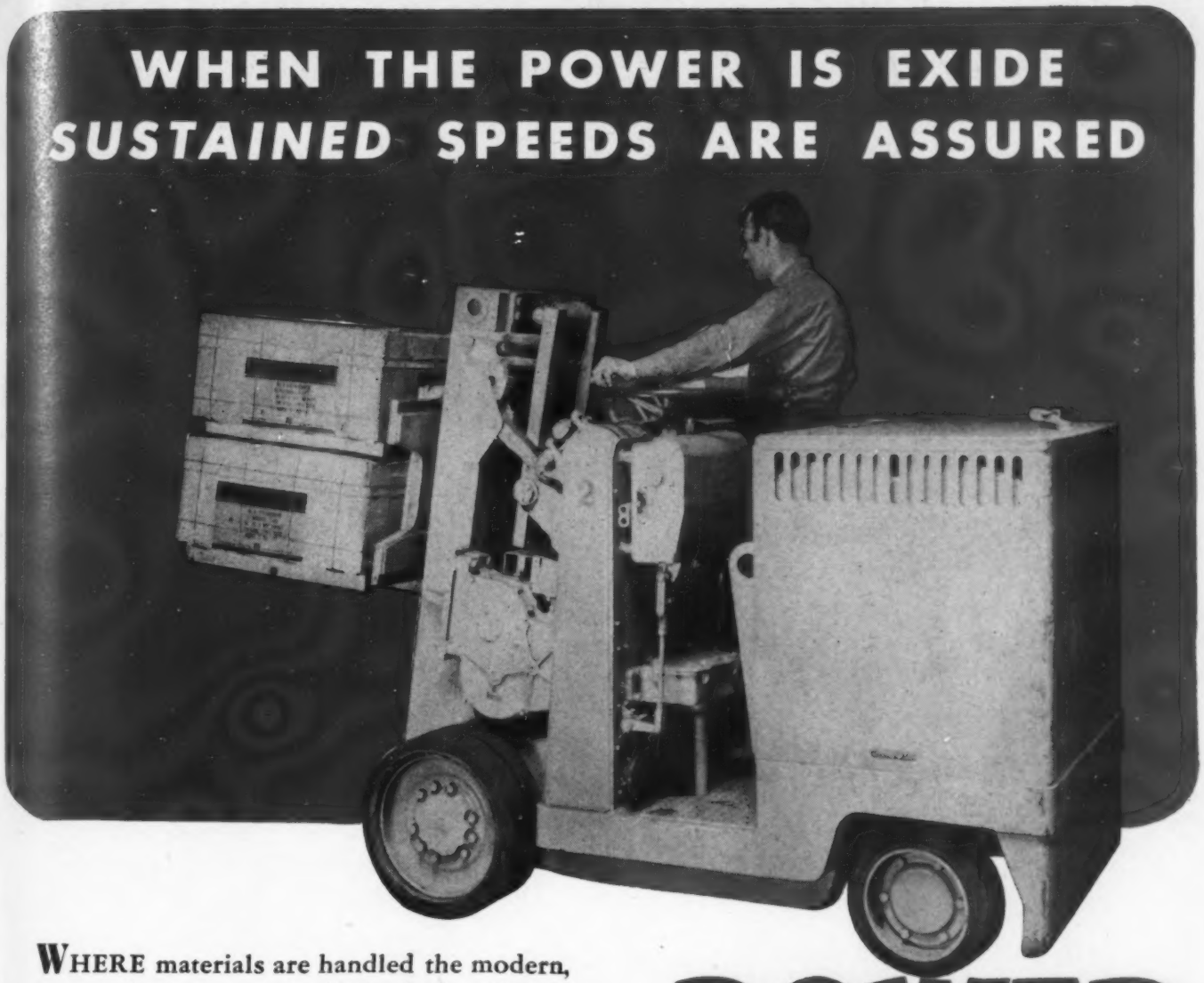
AIR JECTOR

Ask Your Furnace Manufacturer to Investigate—We Assure Him Fullest Cooperation

V-80

MORGAN CONSTRUCTION CO. • WORCESTER, MASS.

WHEN THE POWER IS EXIDE *SUSTAINED* SPEEDS ARE ASSURED



POWER

WHERE materials are handled the modern, economical way—as unit loads by electric industrial trucks—tonnage figures climb and handling costs go down. And when the motive power is Exide, sustained speeds, all day long, are assured.

Thousands of Exide Batteries are in service on the factory and warehouse fronts . . . helping to keep war supplies moving smoothly . . . and getting them off to a running start. Exides are specially designed for this important service. They have the extra power and rugged construction the job demands. For dependability, long-life and ease of maintenance, you can always count on Exide Batteries.

Write us for a FREE copy of the bulletin "Unit Loads," prepared by The Electric Industrial Truck Association. It tells how to cut handling costs up to 50% . . . covers latest developments in materials handling . . . and includes actual case histories.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

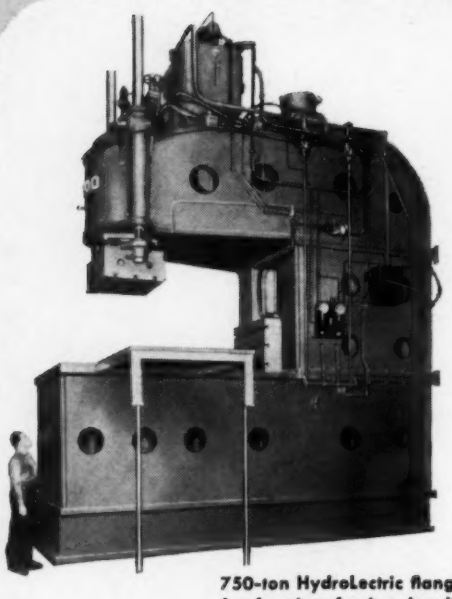
NOT JUST **PRESSES**

but

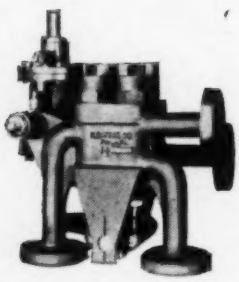
MEANS OF CUTTING COSTS

Manufacturers must use the most efficient production equipment available to remain in business and maintain full employment. Experience has proven that hydraulic presses are at the top of the list of important production tools.

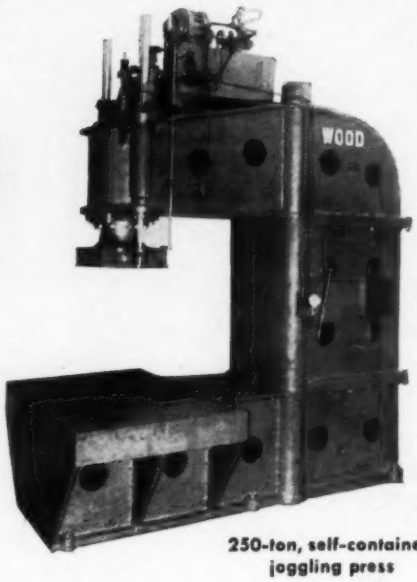
The presses here illustrated merely suggest the wide variety of sizes and types that Wood builds. Included in Wood experience are forging, forming, bending, drawing, crimping, forcing, joggling, straightening, stamping, flanging and every other type of hydraulic press for the metal working industries. Why not consult Wood engineers? Write outlining your requirements.



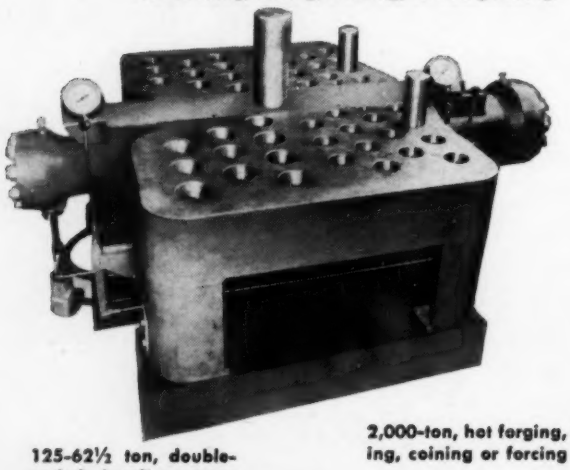
750-ton HydroLectric flanging press, used also for forming, forcing, bending, or straightening



4-way operating valve, air cylinder operated



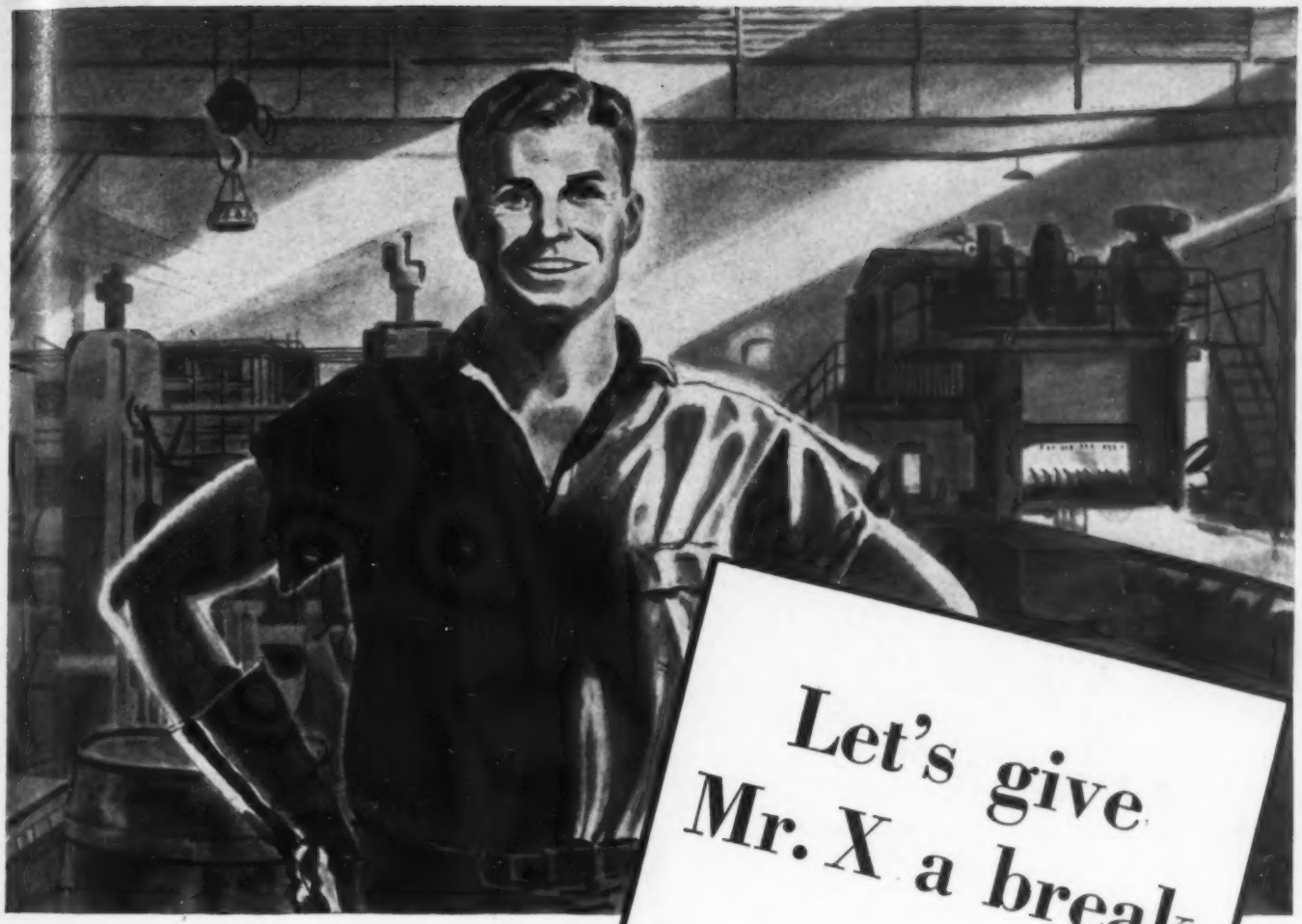
250-ton, self-contained, joggling press



125-62½ ton, double-ended bending press

2,000-ton, hot forging, forming, coining or forcing press

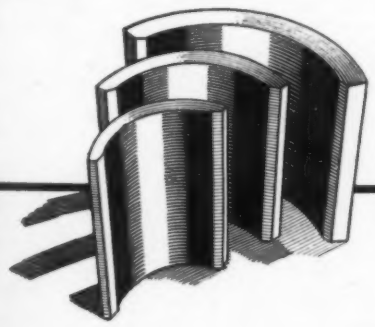
EST 1803 R. D. WOOD CO. PUBLIC LEDGER BUILDING INDEPENDENCE SQUARE PHILADELPHIA 5, PA.



Let's give Mr. X a break

MR. X is the man who gets those tough rolling assignments . . . the man who is doing his best to roll those stiff production schedules, accurately and on time.

HE'S THE ROLLER, and he's doing a fine job, but we think Textolite roll-neck bearings can help him a lot, and there are plenty of good reasons.



Save with Textolite

1. Maximum production
2. Low-power consumption
3. Long life
4. No grease bills
5. No fire-cracked roll-necks

BUY WAR BONDS

- **TONNAGE.** Minimum loss of power due to friction permits highest possible mill speeds and maximum reduction per pass.
- **PRODUCTION.** Because Textolite wears away so very slowly, its replacement involves a minimum of shutdowns.
- **TOLERANCES.** Since the wear per pass is nominal, mill adjustments are reduced and off-gauge material almost eliminated.

So give Mr. X a break and supply him with G-E TEXTOLITE roll-neck bearings.

General Electric, for over fifty years in the plastics business and now the world's largest molder of plastic parts, supplies to the steel industry this high-quality bearing that has been formulated in the extensive plastics research and development laboratories of the General Electric Company.

For further information write section W-71, General Electric Company, Plastics Divisions, One Plastics Avenue, Pittsfield, Mass.

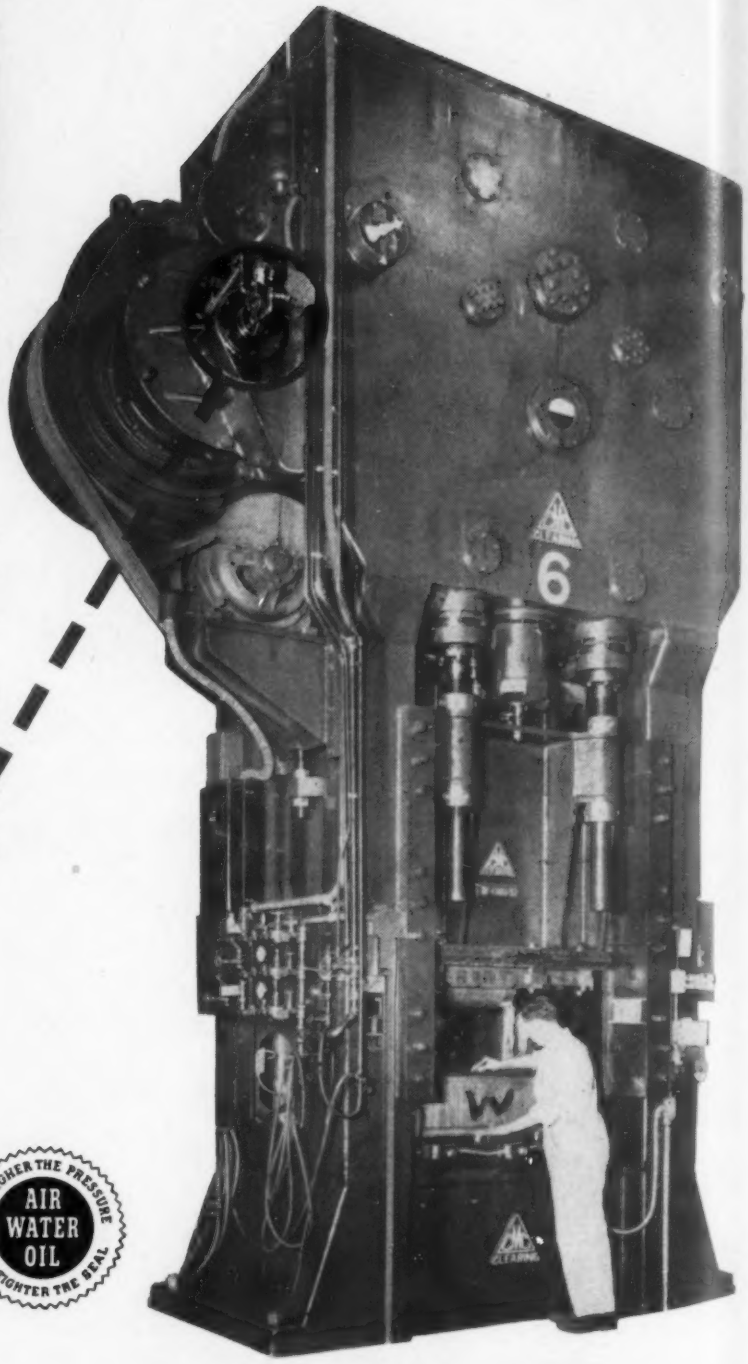
Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "G-E House Party" every weekday 4:00 P.M. EWT, CBS.

GENERAL ELECTRIC

PD-71

Quick-As-Wink

This 300-ton press in service at Boeing Aircraft Co., is a product of Clearing Machine Corporation, Chicago, Illinois.



300 ton press controlled by *Quick-As-Wink*

A 1" No. CL1690-S3 Quick-As-Wink solenoid operated 3-way air valve controls an air actuated clutch and brake on this 300-ton double action press.

C. B. Hunt & Son manufactures single and double solenoid valves; hand, foot, and diaphragm operated valves for air; also hand and pilot operated hydraulic types for water or oil applications up to pressures of 5,000 pounds, in standard and special sizes.

THE HIGHER THE PRESSURE — AIR WATER OIL — THE TIGHTER THE SEAL

Write for the engineering-styled, easy-to-use, Quick-As-Wink catalog. *Complete* data you can use for your specification work.

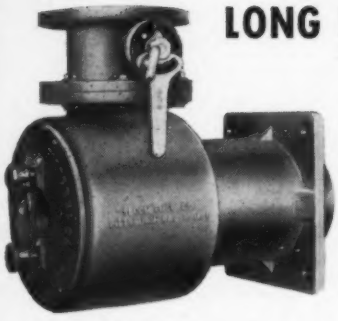
C. B. HUNT & SON

1863 E. PERSHING ST.
SALEM, OHIO

FOR IDEAL HEATING CONDITIONS...

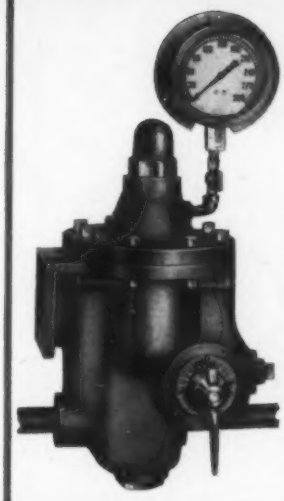
BLOOM *Specialized* FURNACE EQUIPMENT

To obtain greatest effectiveness and economy, your furnace equipment must be suitable for the job, and properly engineered. Bloom furnishes both equipment and application "know-how."



LONG FLAME BURNER

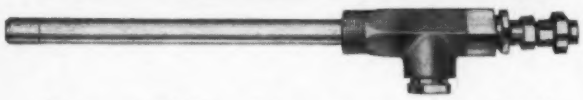
Long Flame Gas Burner, the predominant luminous flame gas burner in the steel industry. Many installations have increased production 25% to 50% with corresponding fuel economies. New bulletin is available showing heat transfer rates of luminous flames.



CONSTANT FLOW OIL VALVE

To assure constant oil flow to the burners under conditions of varying line pressure, the Bloom Constant Flow Oil Valve is used. Fast acting; never "overshoots" at reversal. Entirely automatic. Calibrated dial indicates flow.

STEAM ATOMIZING OIL BURNER



Steam atomizing oil burner, a simple rugged oil burner for general application and rough usage; an ideal burner for use in combination with the Bloom Long Flame Gas Burner. Customers report excellent results with stand-by systems using heavy oil.

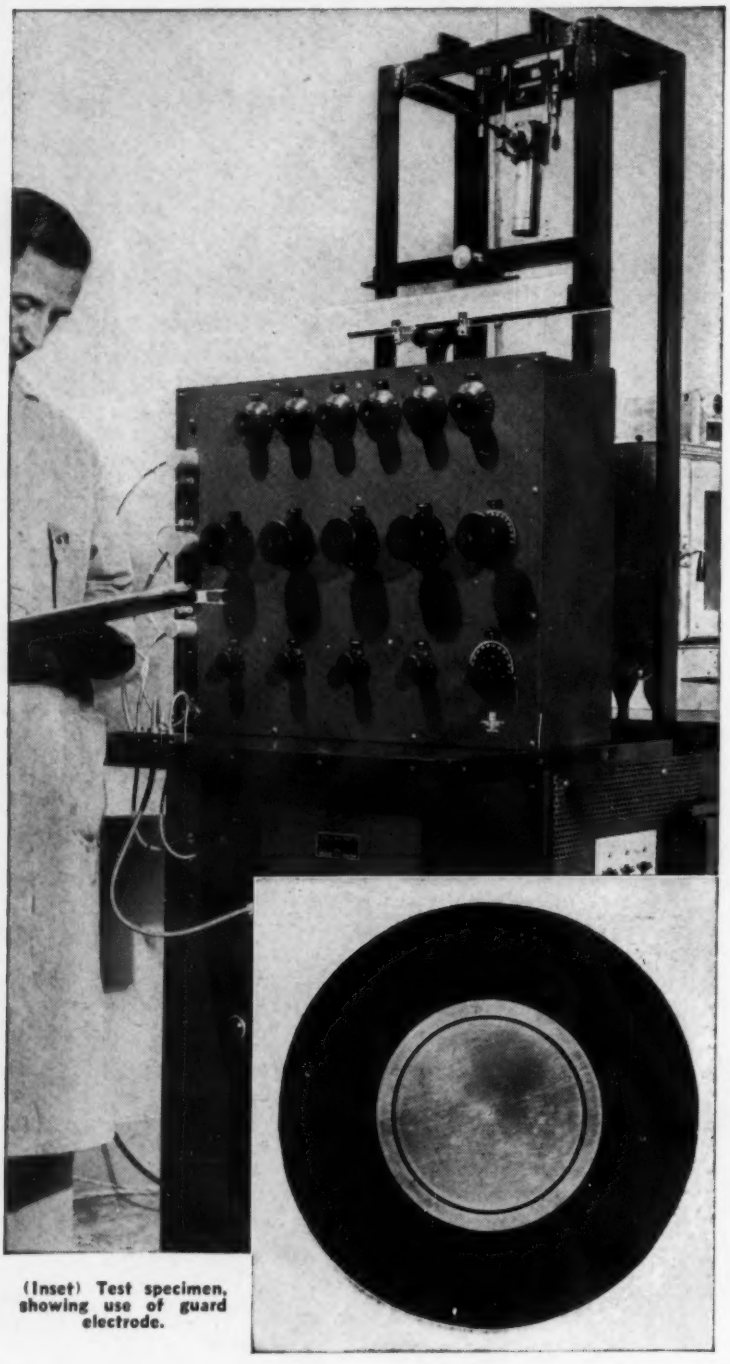
COMBUSTION SPECIALISTS

A staff of experienced engineers thoroughly familiar with a wide variety of heating furnace problems will help you get the results you want in your furnace equipment. Correct application is just as important as good equipment, and Bloom Engineering's combustion specialists are available to get for you the results you want.

BLOOM ENGINEERING COMPANY

857 West North Avenue, Pittsburgh 12, Pa.

SERVICE!



(Inset) Test specimen, showing use of guard electrode.

DOLPH Research and Testing Facilities Include Equipment to Determine Power Factor and Dielectric Constant of Insulating Varnish.

Data on dielectric constant and power factor of insulating varnish and insulating materials has long been of importance in the electrical field. Realizing this, the JOHN C. DOLPH COMPANY installed a Leeds and Northrup high voltage modified Schering Bridge. This measuring equipment is noted for its high degree of precision and is designed primarily for use on frequency of sixty cycles. The power factor of the specimen is read directly at this frequency on most materials. Operation can be effected up to a maximum voltage of 10 K.V.

Determination of dielectric constant and power factor is obtained while the specimen is under a voltage stress, thereby simulating actual operating conditions. This data is obtained with the highest possible degree of accuracy by the use of guard electrodes. (See Illustration.)

TWO PURPOSES SERVED

Production Check Any variations in quality due to improper processing of the varnish or variations in the raw materials used in formulations, can usually be detected through dielectric measurements.

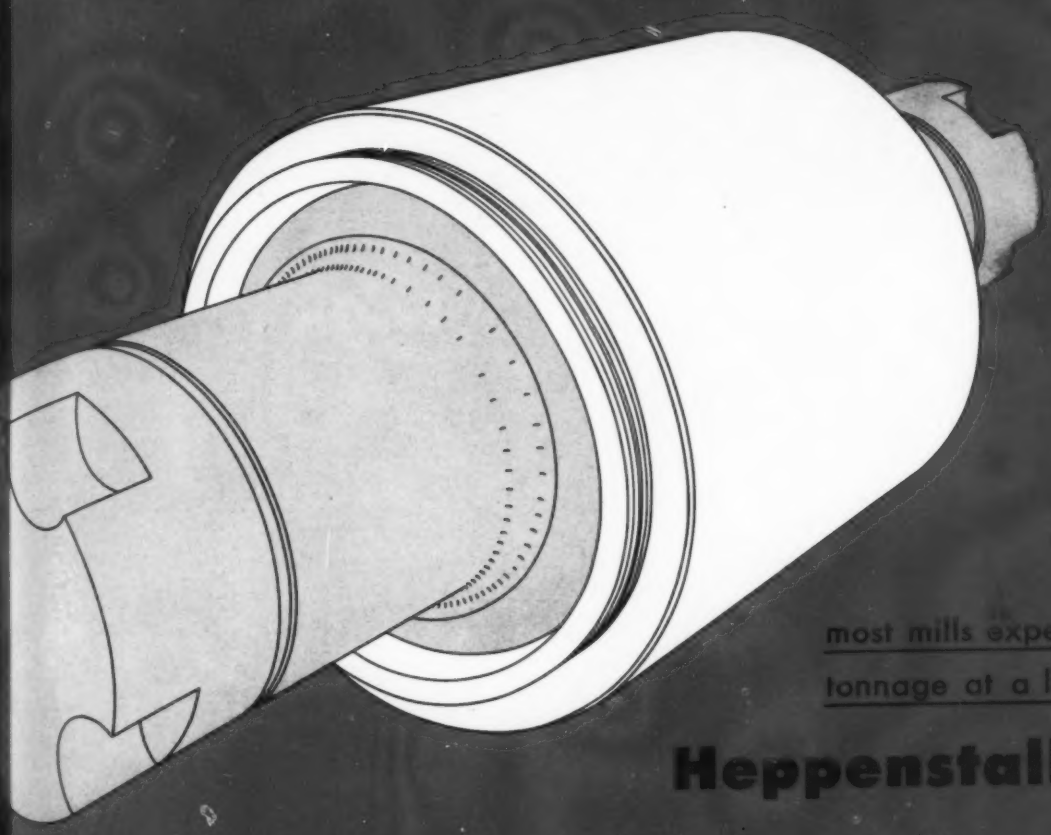
Further Research Today, electrical manufacturers are seeking pertinent information on the electrical characteristics of insulating varnish films. We, of the JOHN C. DOLPH COMPANY, are now in a position to handle requests of this nature and we make this service available to you without any obligation on your part. Send us your inquiries and we will be glad to furnish you with the desired information.

Insulating Dolph's *Varnish Specialists*

JOHN C. DOLPH COMPANY

168 EMMETT STREET - NEWARK 5, N. J.

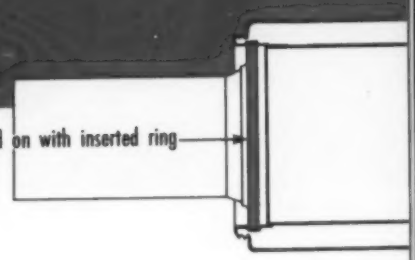
There's a sound reason why



most mills expect and get greater tonnage at a lower cost with . . .

Heppenstall Sleeves

for back-up rolls



Heppenstall back-up roll sleeves have 3 important, proved advantages over a solid roll: (1) They last much longer; (2) They cost less; (3) They eliminate the expense of scrapping a worn roll . . . Being a relatively small mass of metal with no necessity for the usual compromise between strength of necks and hardness of surface, these sleeves permit the incorporation of all Heppenstall's skill in metallurgy, forging and heat treating . . . and they can be furnished in any workable degree of hardness desired. Write for the complete story. Address Heppenstall Co., Pittsburgh, Pa.

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POOLE

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OOLE FOUNDRY & MACHINE COMPANY

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A Washington Magnesite Ramming Mixture

FRONT WALLS - BACK WALLS - END WALLS

Although it is less than three years since the introduction of H-W Magnamix as a commercially available refractory, this Harbison-Walker product has become firmly established in the basic open hearth steel industry. More than 50 complete open hearth bottoms of H-W Magnamix are in successful operation.

The high magnesia content of H-W Magnamix (80% MgO) and the density to which it packs when rammed, make it the outstanding refractory for new bottoms, for bottom repairs and for taphole repiping and maintenance.

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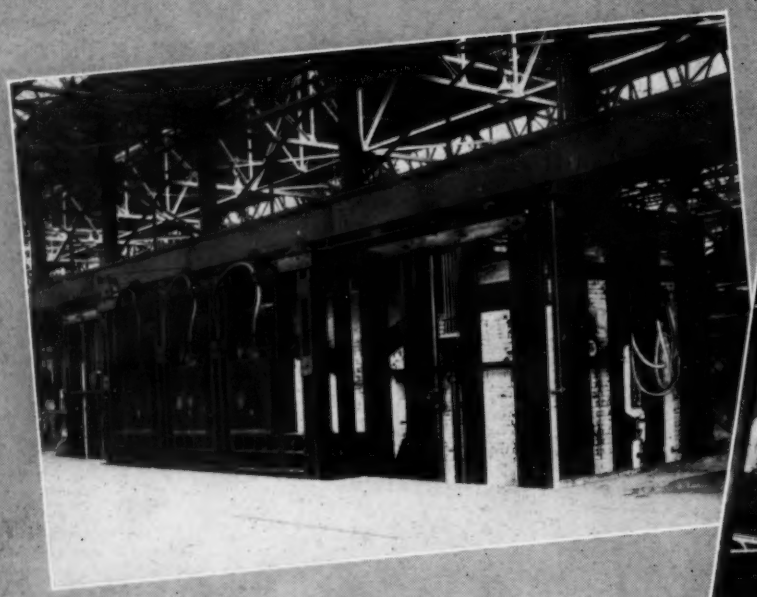

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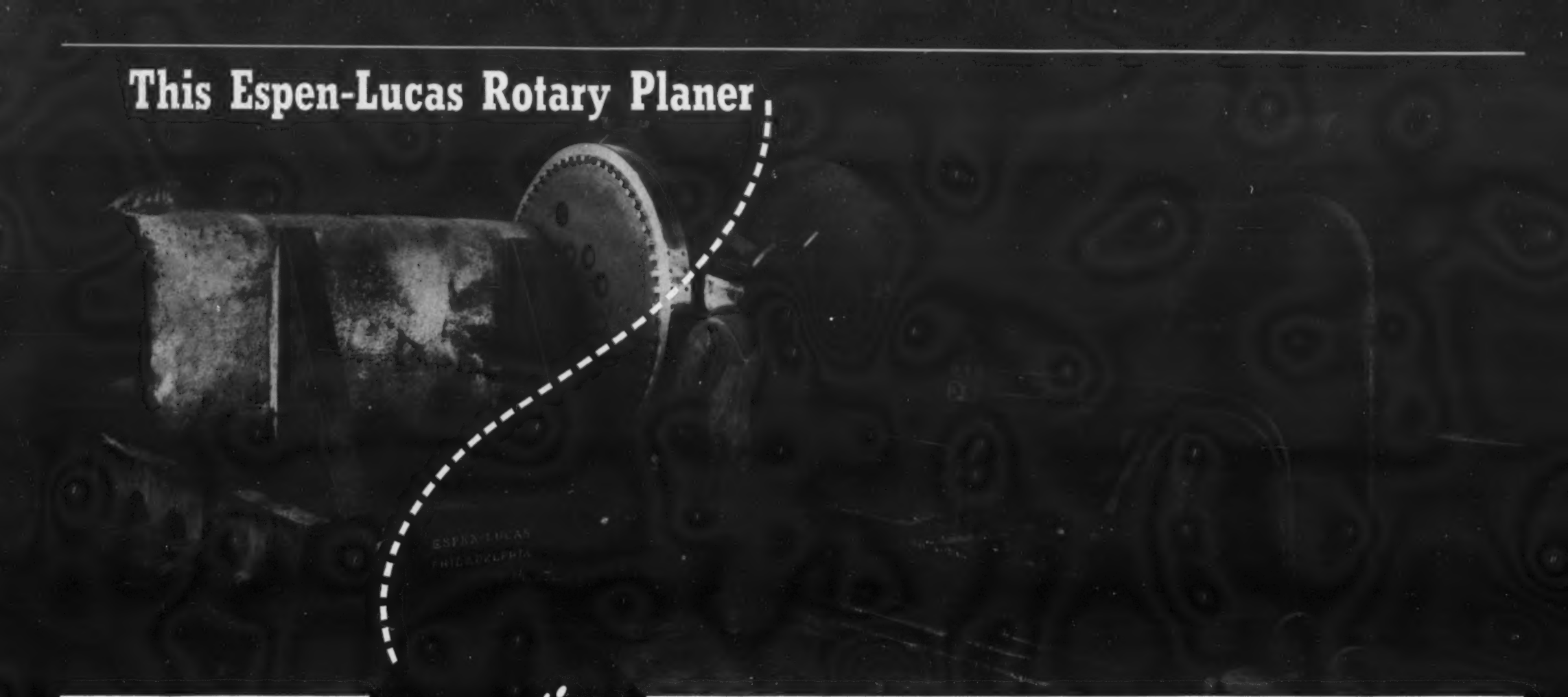
This Espen-Lucas Rotary Planer



Ruggedly built, with ample weight for fast, heavy milling. Close-spaced cutters, many more than are usually found on such planers. Hydraulic feed. Espen-Lucas makes many types of rotary planers that are fast, low-cost producers.

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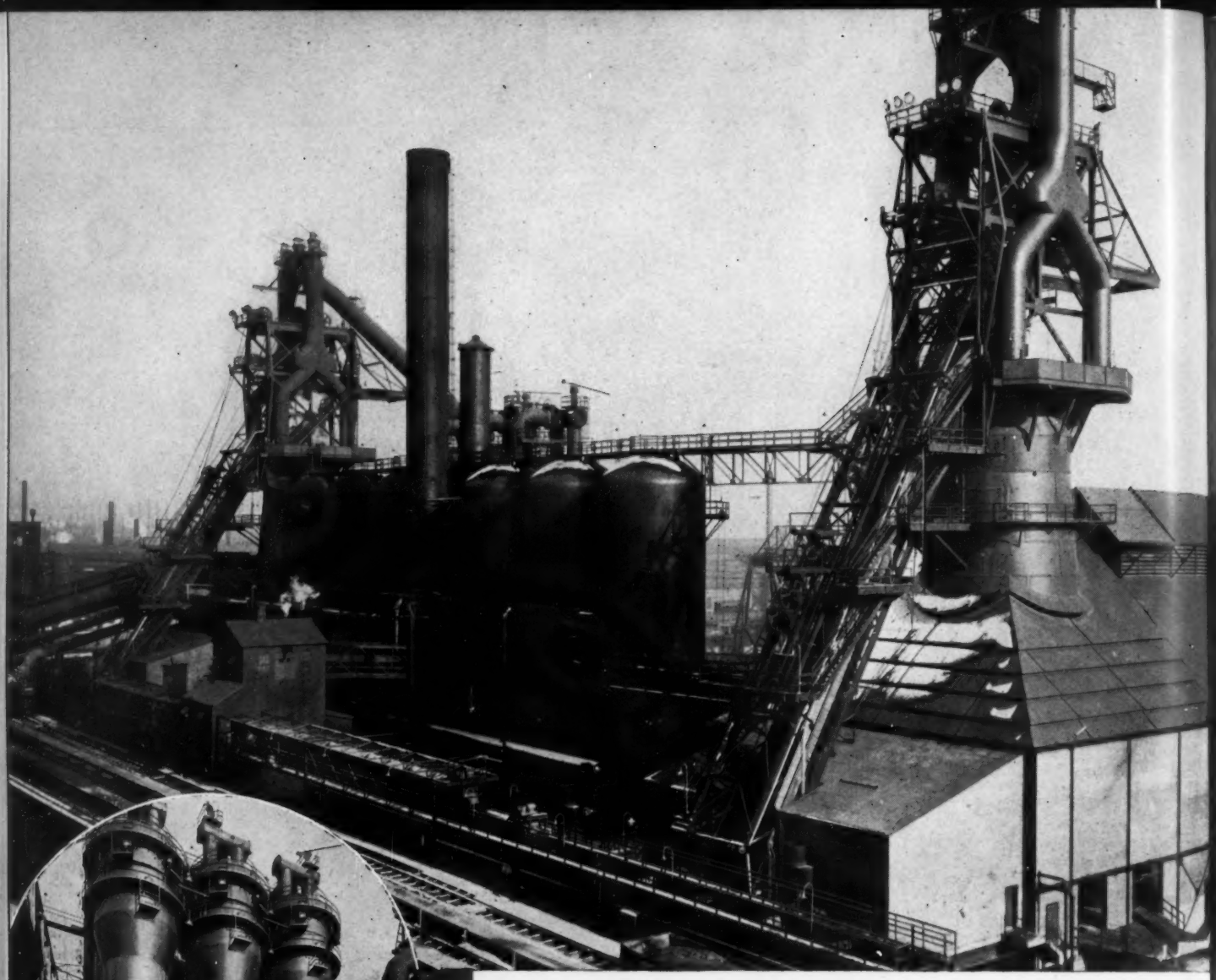

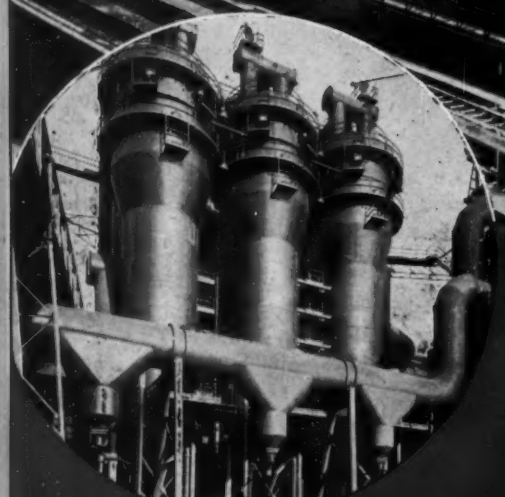

View of complete plant showing efficient arrangement and use of space. In Circle: Close-up of three washers with superimposed precipitators.

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• Design, engineering and construction of the plant shown above were recently completed by the McKee organization.

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Personnel News

R. A. Lewis has retired as general manager of the Bethlehem plant of Bethlehem Steel Company. He will continue in consulting and advisory capacity. **J. M. Sylvester** has been appointed general manager, while **A. D. Shankland,** engineer of tests, will succeed Mr. Sylvester as assistant general manager.

Mr. Lewis entered the employ of Bethlehem in 1907, as assistant master mechanic of the Bethlehem plant. In 1916 he was made general superintendent of the Lehigh division, and in 1918, general manager of the Bethlehem plant.

Mr. Sylvester has been with Bethlehem since 1914. For several years he was in charge of the proof-firing of all foreign ammunition. In 1917 he became superintendent of the projectile departments. He was appointed superintendent of forge shops and projectile departments in 1920, and in 1923 became superintendent of forges, shops, and foundries. In 1927 he was named superintendent of the Lehigh division, and in 1936 assistant general manager of the Bethlehem plant.

Mr. Shankland began his work with Bethlehem in 1914, in the chemical laboratory. Through successive steps in the organization he was advanced to superintendent of No. 1 and 3 open hearths in 1925, and in 1928 he was also given charge of the Lehigh mills. In 1934 he was appointed engineer of tests.

I. E. Madsen has joined the staff of the Association of Iron and Steel Engineers, where he will work in connection with research and editorial activities of the Association. Graduated from Massachusetts Institute of Technology in 1933, Mr. Madsen has done considerable research work there, as well as at Columbia and Lehigh universities, and has written many technical reports. He conducted the research on crane girders on which the latest revision of the A. I. S. E. Crane Specifications was based.

Since 1941 Mr. Madsen has been in the Corps of Engineers, United States Army, entering as a first lieutenant and advancing to lieutenant colonel. During this service he was awarded the Legion of Merit for reconnaissance work in Burma and China.

Carl A. Ilgenfritz has been appointed vice-president in charge of purchases of Carnegie-Illinois Steel Corporation, a newly established management responsibility, and **R. L. Van Cleve** was named general purchasing agent of the company.

Mr. Ilgenfritz leaves his position as manager of purchases and raw materials of Republic Steel Corporation to assume his new duties with Carnegie-Illinois. A native of Youngstown, Ohio, he commenced his business career as a storekeeper for the Youngstown Sheet and Tube Company. He shortly entered the mechanical department and joined the Brier Hill Steel Company in 1913, being made purchasing agent in 1918.

Subsequently, for several years Mr. Ilgenfritz was vice-president of the Stroh Ilgenfritz Company of Youngstown, Ohio, a company dealing in raw materials which he organized and from which he resigned in 1924 to become assistant purchasing agent of the Youngstown Sheet and Tube Company. When Republic Steel Corporation was organized in 1930, he became director of purchases having previously held the same position with the Central Alloy Steel Corporation of Massillon, Ohio, one of the companies included in the merger. He was made manager of purchases and raw materials for Republic in 1933.

Mr. Van Cleve is a graduate of Princeton University and entered the employ of the Corporation early in 1914 at the Edgar Thomson Works. After several years at that plant, he was transferred to the office of special agent in charge of blast furnace products and scrap. He was made assistant purchasing agent—Pittsburgh district in October, 1935.

Frank J. Rief, general purchasing agent, Carnegie-Illinois Steel Corporation, has retired after more than thirty-three years of active and efficient service with the company.

I. E. MADSEN

C. A. ILGENFRITZ

R. L. VAN CLEVE

Emil C. Ostlund has been appointed chief industrial engineer of American Steel and Wire Company, subsidiary of United States Steel Corporation. He succeeds **Cecil W. Guyatt,** recently named assistant to the chairman of operating committees, United States Steel Corporation of Delaware.

Mr. Ostlund was born in Brockton, Massachusetts, on June 10, 1911, and was graduated from Worcester Polytechnic Institute with a B.S. degree in Mechanical Engineering. He has been employed by the Wire Company since October, 1936, when he started as an industrial engineer at Worcester, Massachusetts. He was subsequently works industrial engineer and district industrial engineer at Worcester before being transferred to Cleveland in December, 1943, as assistant chief industrial engineer, which position he has held up to the present time.

R. E. Nagel, formerly with the Universal Oil Products Company of Chicago, has accepted a position with The Fluor Corporation, Ltd., of Los Angeles, and will be located at Fluor's New York offices as district sales manager. Mr. Nagel has been with the Universal Oil Products Company for the past twenty-four years during which time he served in various capacities.

Lauchlin M. Currie has been made vice-president in charge of research for National Carbon Company, Inc. Dr. Currie has been acting director of research since 1942, except for fifteen months during which he was associate director of the division of war research of Columbia University.

After receiving his A.B. degree at Davidson College in 1918, Dr. Currie worked for three years with the Hooker Electrochemical Company in Niagara Falls. He then entered Cornell University on a Sage Fellowship and received his Ph.D. in 1925. Immediately afterward he joined National Carbon Company, Inc., as a research chemist in the laboratories at Cleveland.

In 1929 Dr. Currie became the superintendent of National Carbon's Edgewater Works in Cleveland, and in 1931, assistant to the director of research for the company. Two years later he was put in charge of the Vinylite Division of National Carbon Company which led in 1941 to his appointment as superintendent of the Vinylite Division of Bakelite Corporation. Both companies are units of Union Carbide and Carbon Corporation. He returned to National Carbon Company, Inc., as Acting Director of Research in 1942.

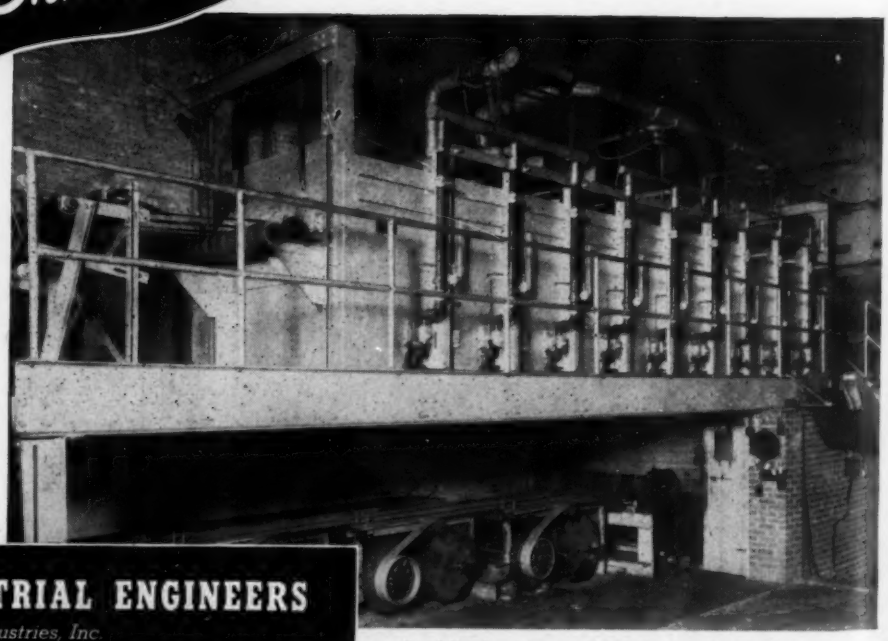
Frank J. Laskey, general purchasing agent of Republic Steel Corporation, has been made manager of purchases and raw materials, succeeding C. A. Ilgenfritz.

Succeeding Mr. Laskey as general purchasing agent is **William T. Adams,** chief electrical buyer.

Mr. Laskey, who is a native of Rock Creek, Ohio, began his business experience with the General Fireproofing Company in Youngstown in 1906, leaving the company's purchasing department in 1917 to become purchasing agent for the Liberty Steel Company of Warren. In 1919 he became general purchasing agent of the Newton Steel Company, serving as the result of successive mergers, in the same capacity with the

P.I.E.

DIRECT-FIRE Stainless Strip Annealing Furnace



This special furnace provides the answer to the problem of heat treating high alloy strip steel. It eliminates the need for the use of a muffle, furnishing an atmosphere which produces scale that is easily pickled. Initial cost is relatively low, fuel savings and economical maintenance are assured, and the furnace will fit well into continuous straight line production. Write for further information.

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For full information on AMCO Recuperative Pit Furnaces, Open Hearth Furnaces and Large Recuperative Rotating Hearth Furnaces, write to AMSLER-MORTON DIVISION of Union Industries, Inc., Fulton Building, Pittsburgh 22, Pa. P-3

F. J. LASKEY

W. T. ADAMS

C. H. SAITER

Corrigan-McKinney Steel Company and then with Republic.

Mr. Adams, who was born in Rumania and whose father installed the first electric light plant in that country, grew up in Canton, Ohio, and in 1919 entered the Stark Division of Berger Manufacturing Company, leaving there in 1926 to become sales manager of the Moock Electric Supply Company of Canton. He came to Republic as chief electrical buyer in 1933.

Charles H. Saiter has been appointed sales manager of the heavy machine division of The Cleveland Crane and Engineering Company, Wickliffe, Ohio. This is a new sales division which will be responsible for the sales of heavy Cleveland overhead traveling cranes, as well as Steelweld bending presses, bulldozers and special machinery. Until recently the Steelweld line of machines was distributed through a general sales agent.

Mr. Saiter was sales manager of the former Heavy Crane Department, and has been with the company for 23 years in various engineering and sales capacities.

Coup de Main: The battle royal or main bout, which immediately followed a general softening-up during knighthood forays.
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CARBON BRUSHES
MORGANITE BRUSH COMPANY, INC., LONG ISLAND CITY 1, N. Y.
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Looks as though new methods sometimes bust an old problem wide open!
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Matthews marking machines, dies, type and fixtures supplied for marking names, codes, trade names, trade marks, patent numbers, etc., on all types of industrial parts or products.

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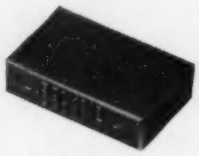
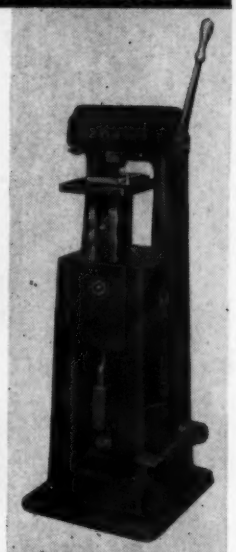


Flat Die for Marking Round Parts

Round Die for Marking Flat Parts

Roller Die with Interchangeable Type



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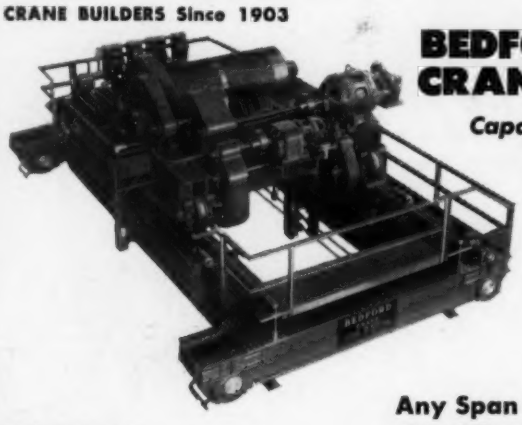

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BEDFORD FOUNDRY & MACHINE CO.

Engineers Designers Fabricators

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Gray Iron Castings

Henry F. Dever has been elected president of the Brown Instrument Company, a subsidiary of the Minneapolis-Honeywell Regulator Company.

Mr. Dever, who has been serving as vice-president in charge of engineering for Minneapolis-Honeywell, succeeds **Charles B. Sweatt** as president of Brown. The latter, a vice-president and director of Minneapolis-Honeywell, has withdrawn from Brown and will henceforth devote his entire attention to supervision of the expanded sales activities of the Honeywell organization and its subsidiaries.

Mr. Dever will also assume the responsibilities of **E. B. Evleth,** general manager of Brown Instrument, who, because of ill health, has requested that he be relieved of his duties at an early date.

Engineering activities of the parent company will be under the direction of **W. J. McGoldrick** who will direct the company's engineering activities in the domestic and industrial heating and air conditioning controls field, and the operation of the aeronautical engineering department which developed the electronic Autopilot and other aircraft equipment for the Army Air Forces.

Richard W. Berg has been made district engineer for the Pittsburgh territory of the Bantam Bearing Division, The Torrington Company.

Mr. Berg has been with Bantam since 1944. He was previously employed by Mesta Machine Company, West Homestead, Pennsylvania, as an electric furnace melter, and by Carnegie-Illinois Steel Corporation as roller and industrial engineer at the Irwin Works.

F. A. Wright has been named assistant general sales manager for Cutler-Hammer, Inc. Mr. Wright has been associated with the company since 1927, first in the St. Louis district sales office, and then as manager of resale sales at Milwaukee.

Heber V. Lauer has been made field supervisor for the raw materials, fuel and power division, Chicago District, Carnegie-Illinois Steel Corporation. Mr. Lauer, a graduate in engineering from the University of Illinois, was assistant division superintendent of coke plant and blast furnaces at the company's Gary Steel Works.

J. H. Eisaman has been appointed superintendent, No. 2 electric furnace shop at South Chicago Works, Carnegie-Illinois Steel Corporation. Eisaman, formerly assistant superintendent of that plant's electric furnace and forge press department, holds a degree in metallurgical engineering from the University of Wisconsin.

Milton C. Angloch, a director, member of the executive committee and vice-president of Jones and Laughlin Steel Corporation in charge of raw materials, has resigned after 45 years of service with the company.

Carl C. Henning, who has been general metallurgist of Jones and Laughlin Steel Corporation, has been appointed manager of raw materials, and **David T. Rogers,** who has been assistant metallurgist at the Otis Works of the corporation, has been appointed general metallurgist, succeeding Mr. Henning.

J. F. CONE

Charles T. Moke, purchasing agent of The Youngstown Sheet and Tube Company of Youngstown, Ohio for the past 35 years, has retired and will make his future home in Wooster, Ohio. **Jared F. Cone** has been appointed purchasing agent of machinery, construction and maintenance repair and operating supplies for the

J. D. SLOAN

Youngstown Sheet and Tube Company, and **James D. Sloan** was made purchasing agent of raw materials.

Mr. Cone has been associated with The Youngstown Sheet and Tube Company for the past 27 years. He has been assistant purchasing agent since 1929.

Mr. Sloan has been associated with the company for the past 15 years. From February, 1942 until November, 1944, he had been "on loan" to Raw Materials Branch, Scrap Section of the War Production Board.

Frederick H. Lewis has been appointed manager of orders of the corporation, succeeding **F. E. Jamieson,** retired. Mr. Lewis has been with Jones and Laughlin in various capacities since 1918.

J. W. Hacker was named executive assistant, operating department, at National Tube Company's headquarters in Pittsburgh, Pennsylvania.

Mr. Hacker, who has been general superintendent of

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NEW Lovejoy Catalog and Selector Charts provide you with *complete* data in most convenient form. Simplified Selector Charts eliminate much tedious figuring — lead you directly to couplings for *your* services. Should be in every engineer's file.

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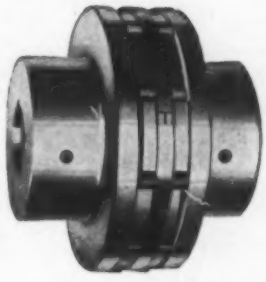
Besides instant-reading tables on bores, horsepowers, dimensions, weights, prices, etc., new Lovejoy data describes *cushion materials for every kind and demand of service* — armored rubber, rubber duck, belting leather, brake-lining, etc.

Exemplifies construction. Free-floating load cushions suspended between metal jaws, adjust instantly to every emergency — misalignment, vibration, shock, backlash, etc. Cushions always in sight. No shut-downs for changing. Never need lubrication. Extremely quiet. Type "W" is for duties from 2 to 2500 h.p. Bores 1½" to 16¾".



L-R Type "W"
Pat. and Pats. Pending

Couplings for 1/6 to 2500 h.p. duties shown in Catalog.

Send for the new L-R Catalog and Selector Charts. Full set of Charts supplied with catalog, without cost. Of immediate assistance whatever your coupling problems. Lovejoy also engineers special couplings to requirements.

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Pittsburgh Office: EDW. J. BOYLE CO., 508 Grant St.

the company's Christy Park Works, McKeesport, Pennsylvania, since April, 1943, will be succeeded by **L. V. Johnson,** assistant general superintendent of the plant since June, 1941.

Mr. Hacker is a graduate of the University of Michigan. He was formerly with Republic Steel Corporation and Pittsburgh Crucible Steel Company before he became a consulting engineer on cost and management problems. He joined the National Tube Company organization in 1940 and was chief industrial engineer of the company until he became general superintendent at Christy Park.

Mr. Johnson, who was born in McKeesport, was educated in the public schools there and attended Carnegie Institute of Technology. He began his association with National Tube Company working summer vacations at Christy Parks Works. He was employed as a draftsman and was successively promoted to chief draftsman, chief engineer and assistant general superintendent.

Frank G. Corregan has been named purchasing agent of Pittsburgh Limestone Corporation, succeeding **Robert Carter,** who died recently.

At the same time announcement was made of the appointment of **J. N. Suliot** as superintendent of the company's Moler Dolomite Quarry at Millville, near Martinsburg, West Virginia, replacing Mr. Corregan.

Mr. Corregan has been with the company 24 years, the past 18 as superintendent at Millville. He is a graduate of Cornell University and served overseas in World War I.

Mr. Suliot has been with the company six years, the past three as plant engineer at Hillsville Limestone Quarry near New Castle, Pennsylvania. He is a graduate of Purdue University.

James De Kiep has been made chief engineer in charge of electrical and mechanical design and development for Electrical Machinery Manufacturing Company, Minneapolis, Minnesota. Mr. De Kiep was formerly manager of the a-c motor engineering department at Westinghouse Electric Corporation. He is an electrical engineering graduate of the University of Michigan, has had extensive experience in the design of rotating electrical machinery, and has written several technical papers including a recent survey on the application of Silicone insulation to electric motors.

A. L. Meyer, of Wynnewood, Pennsylvania, chief of the steel plate section of the War Production Board's Steel Division at Washington, has resigned after more than three years' service with that agency to return to Great Lakes Steel Corporation. Mr. Meyer has been appointed assistant eastern manager of sales, representing Great Lakes Steel in the Philadelphia and New York areas. He joined the W.P.B. on January 27, 1942.

William H. Eichengreen has been appointed manager of the commercial research division of the Inland Steel Company. This unit will be constituted as a new division of the company's sales department. Mr. Eichengreen was formerly assistant manager of the sales promotion division, specializing in sales analysis and market research.

Mr. Eichengreen was first employed in the Inland

GRAPHITE GUS SAYS:

GRAPHITE THRIVES ON HEAT AND PRESSURE

...that's why DIXON'S GRAPHITE ROLL NECK GREASES Cut Wear, lessen machining, save "down" time and power costs

These special made-for-the-purpose roll neck greases stand up where ordinary greases fall down. The lubricating graphite in them will not squeeze out and is virtually immune to heat. They lessen repairs and replacements. Dixon's Graphited Roll Neck Greases lubricate longer—and reduce power costs. Get them for your roll necks—and any other spot where you fight extreme heats and pressures. Send for folder "ROLL NECK LUBRICATION."

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DIXON'S LUBRICATING FLAKE GRAPHITES... All screen sizes. To apply dry, or to fortify oils and greases, and to coat pipe joints and gaskets. Data Sheets Nos. 5, 6, 7 tell the uses.

DIXON'S GRAPH-AIR GUN, Filled with Microfyne Graphite... A dry graphite ejector to lubricate hard-to-reach mechanisms, locks, jigs, tools. Data Sheet #8 gives details of this effective little lubricator.

DIXON'S GRAPHITE SLIPSTIK... This wax-like lubricating stick is used like a crayon for fast rub-on lubrication. Data Sheet #23 tells why it is indispensable for certain uses.

DIXON'S GRAPHITED OILS AND GREASES... Ready-to-use, fortified with Dixon's lubricating flake graphite, provide sustained lubrication for longer periods, especially under extremes of heat and pressure. Data Sheets #13 & 14 tell about Cup Grease and No. 677.

Write Graphite Gus for any of above mentioned Data Sheets and the Directory listing 11 other friction-fighting graphite products.

Steel mills at Indiana Harbor, and later spent a number of years in the pricing and sales promotion divisions. He has been with the company fourteen years and was in charge of the Inland exhibit at the Century of Progress.

J. H. Deppeler, chief engineer of the Metal and Thermit Corporation, New York, New York, has been selected by the American Welding Society to receive the Miller Award for outstanding work contributing to the art of welding. Established in 1927 by S. W. Miller, the award is granted annually by the society.

Mr. Deppeler became affiliated with the Metal and Thermit Corporation in 1912. For some years he was superintendent of the Jersey City plant, later being appointed works manager and then chief engineer of the corporation.

Among the activities of the company in which he took a leading part are the manufacture of metals by aluminum reduction; development of Thermit welding and chromium plating processes; development of Murex welding electrodes; production of incendiary Thermit, and the manufacture of titanium dioxide from rutile.

Mr. Deppeler is one of the founders of the American Welding Society and was its first vice-president. Later he was chosen president of the society, and, in the intervening years, he has served on many technical committees of this and other organizations.

Bennett S. Chapple, Jr., has been named assistant to vice-president-sales, United States Steel Corporation of Delaware. He was formerly assistant manager of sales of the New York district office of Carnegie-Illinois

IMO pump circulating governor oil and lubricating oil for large turbine.

The IMO PUMP requires less space than most other pumps because of the high capacity attainable by its efficient, compact design and high speed operation. If desired, it can be directly connected to, and mounted upon, turbines, motors, engines, or other equipment. In special designs, dimensions and proportions can be varied to meet space limitations. I-128

For further information write for Catalog I-128-I

IMO PUMP DIVISION OF THE DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

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If You Want to Slash
METAL CUTTING & TRIMMING COSTS
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KLING Friction Saws Cut All these Bars and Shapes in a few Seconds
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NO CHANGE OF BLADE OR SET-UP NECESSARY

INCREASES PRODUCTION...

CUTS ALL CLASSES OF STEEL - QUICKLY AND ECONOMICALLY

The versatile ability of the Kling Friction Saw to cut varied structural shapes in any sequence, without change of blade or set-up, permits one machine to handle various types of work which, otherwise, would require several slow speed saws to handle.

The installation of a Kling Friction Saw will quickly convince you of its superiority and advantages over the old type of saw. Furthermore, you will cut your cutting costs — savings will be effected in time and labor because of speed and efficiency of the Kling Saw.

GET COMPLETE INFORMATION

CONSULT KLING ENGINEERS REGARDING YOUR CUTTING PROBLEMS. WRITE FOR BULLETIN No. 9200 GIVING VALUABLE INFORMATION. SENT WITHOUT COST OR OBLIGATION.

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NON-FLUID OIL
IN U.S. PAT OFFICE & FOREIGN COUNTRIES

Modern Steel Mill Lubricant

Better Lubrication at Less Cost per Month

Steel Corporation and since February 1, 1944 has been assistant to president, Firth Sterling Steel Company.

Mr. Chapple began his career with American Rolling Mill Company in 1928, serving as assistant manager of sales development, and later as secretary and sales manager for Insulated Steel Construction Company, a wholly-owned subsidiary of Armco. He joined Carnegie-Illinois in 1936 as manager of market development. In 1942 he held the position of assistant to vice-president, operations, in charge of emergency defense coordination before his transfer to New York a year later.

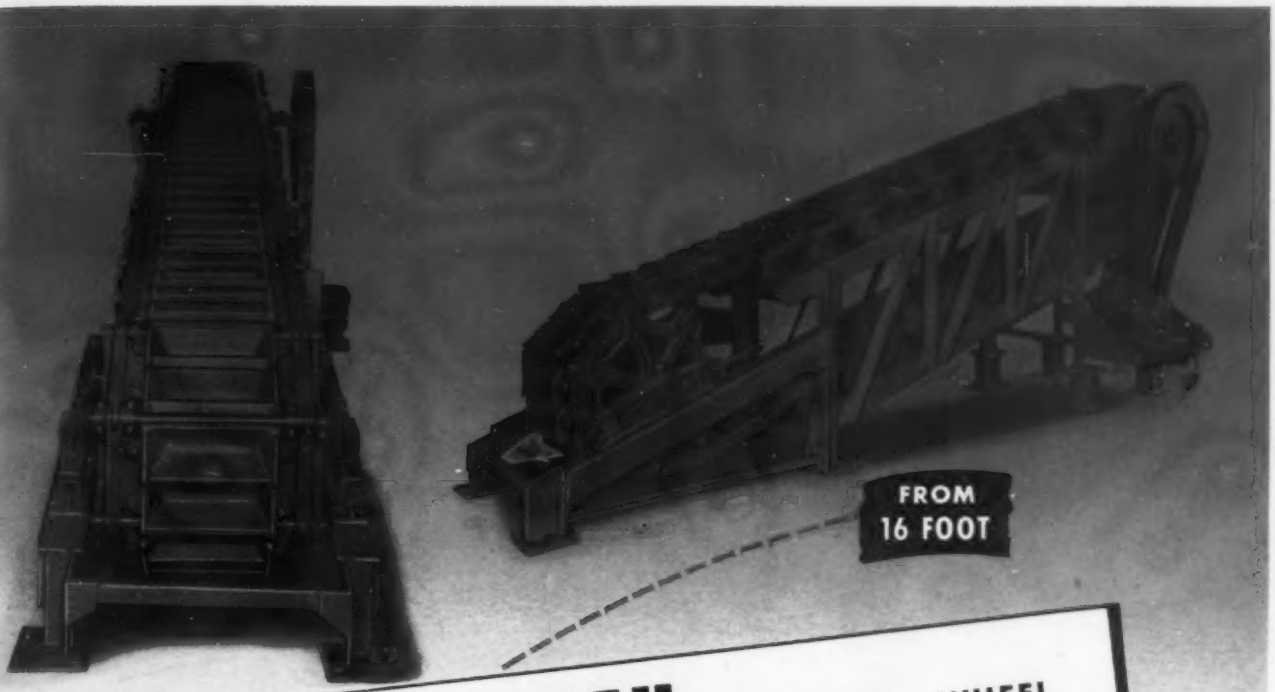
Donald G. Dalton has been appointed assistant general patent attorney for the patent bureau of the United States Steel Corporation of Delaware. A graduate of Carnegie Institute of Technology in engineering, and the University of Pittsburgh, School of Law, Mr. Dalton was admitted to the bar in 1930. At that time he joined the patent law firm of Clarke and Doolittle in Pittsburgh, leaving them in 1939 to enter the patent department of the United States Steel Corporation of Delaware.

W. E. Remmers has been elected vice-president of Electro Metallurgical Company, a unit of Union Carbide and Carbon Corporation.

Mr. Remmers was graduated from the School of Mines and Metallurgy, University of Missouri, in 1923, received the masters' degree the next year and later the degree of metallurgical engineer. After a number of years devoted to research and operating experience in iron and steel, he joined Electro Metallurgical Sales Corporation at Chicago in 1936, and soon became district manager and later division manager. He was transferred to the New York Office in 1941 and in 1944, he was elected vice-president of Electro Metallurgical Sales Corporation.

Obituary

C. C. Pecu, a pioneer in the advancement of lubrication practice and lubricating engineer at the Lackawanna plant of Bethlehem Steel Company for 42 years, died August 11 after an illness of six months. He was 77. Born in Addison, Vermont, Mr. Pecu was educated at Poultney Academy and came to Lackawanna 42 years ago. He was generally credited with being the founder of modern lubrication progress, and was very active in the Lubrication Division of the Association of Iron and Steel Engineers.



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Let Bailey Engineers work with you!

Eliminating traveling wheels—means eliminating *wear* and friction. Stationary, roller bearing idler wheels support the Bailey 15" link mold-chain, which cuts moving parts in half—with *only* one-fourth as many points of wear. Every feature of the patented Bailey Stationary Wheel Pig Casting Machine is designed to give maximum speed and flexibility in Casting, long, continuous, trouble-free service—under top speed operating conditions of 5 to 20 tons per hour.

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UP TO 60 FOOT

WEAR OF PINS AND BUSHINGS IS NEGLIGIBLE

Special interchangeable high manganese steel pins and bushings in the links take all the wear, *are quickly replaceable when* necessary, thus since there is no motion of links on the pins, except when the links are passing over the sprockets, friction and wear is actually negligible.

This...

STEAM-VACU-UNIT

specially designed and manufactured by THE VACUUM CONVEYOR COMPANY for a large steel producer in the Monongahela River valley, efficiently services twelve Open Hearth Furnaces.

What The Vacuum Conveyor Company is doing for a long list of prominent steel companies, it can also do for you. Since no two plants are alike, our engineers, if given a layout of your present facilities, can adapt the Vacuum method for open hearth furnace flue dust cleaning to your particular set-up.

Write today for our Bulletins.

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MAIN OFFICES: CURREN ARCADE BUILDING, NORRISTOWN, PENNA.

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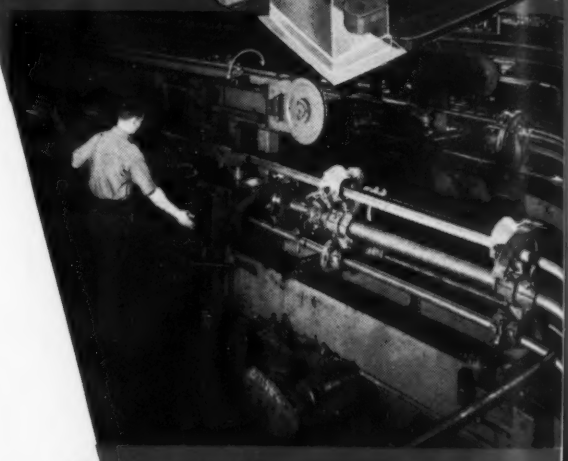
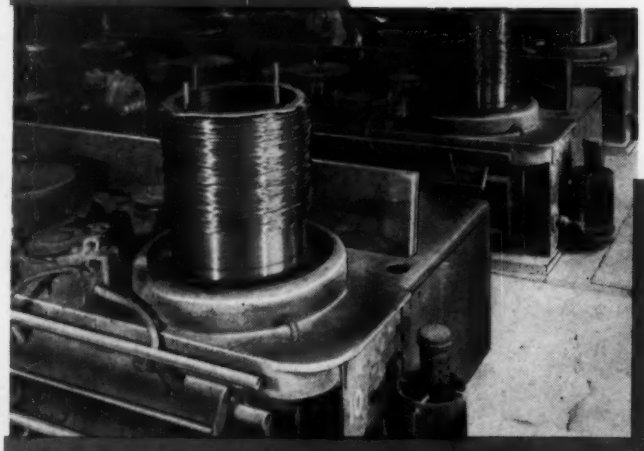
Dependable PRODUCTION

from the
largest BARS
and TUBES . .
. . . to the
smallest WIRE





Vaughn Cold Drawing Equipment

Bars, special shapes, tubes, wire, heavy or fine . . . in steels, alloys, non-ferrous metals for all applications . . . there's a Vaughn Machine for each job, faultlessly engineered, precision built, with durability for years of capacity operation. ● Have a Vaughn representative furnish expert counsel on your production requirements now in the making!

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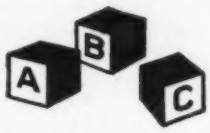
COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Rods . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

TRUMBULL CONTROL CENTERS

Packaged Power Control



"BUILDING BLOCK" SIMPLICITY

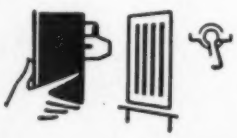
Trumbull Control Centers are not just an assembly of devices, they represent a basic wiring system wherein main bus bars and standardized control units are assembled in individual sections.

These standardized, enclosed units, composed not only of feeder circuit controls but also magnetic combination starters, Sizes 1, 2, 3, or 4, for control of power or lighting feeder circuits, are plugged into prefabricated, standardized vertical sections containing bus bars.

"FILE CABINET" EASE

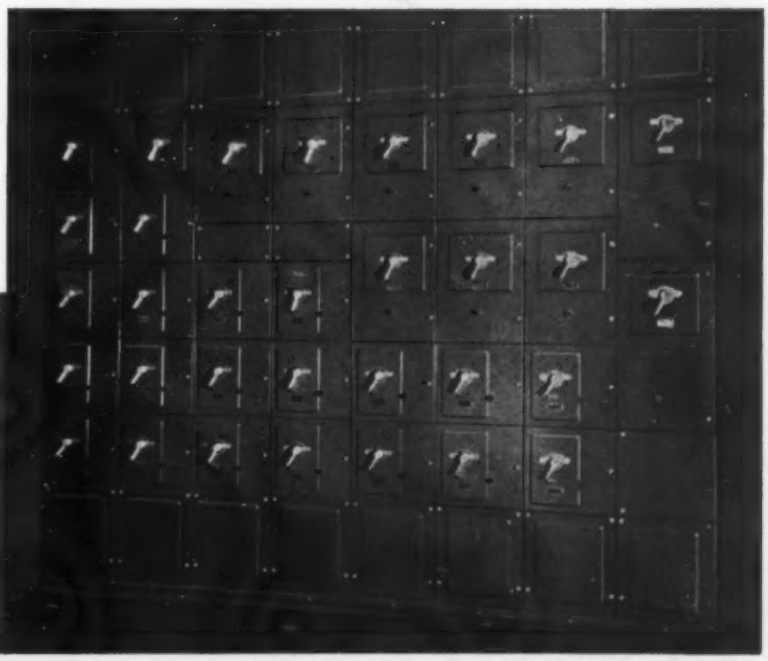
Vertical sections (13½" or 27"), into which control units are arranged as desired, provide extreme flexibility—sections may be added to, rearranged or removed to meet changing requirements. Sections or units of control centers may be shut down, or worked upon without interfering with adjacent units.

Contrast this method of installation with the usual practice of installing a "custom-built" switchboard mounted on skids and most frequently shipped as a single unit of large bulk and weight.



"PLUG-IN" ASSEMBLY

With vertical sections in place, control units used in the 13½" wide sections are quickly plugged in from the front after completion of construction work and wiring. Individual units may be removed, changed and inserted at will for inspection or maintenance purposes.



Typical Trumbull control center—with motor control combination units for 50 H. P. and less (Sizes 1, 2 and 3). "Start" and "Stop" push-button stations are located near the motors themselves throughout the plant with the controllers forming this compact control center—centrally located away from industrial congestion and unfavorable atmospheric conditions. *Entire line illustrated and described in Bulletin 411, sent on request.*

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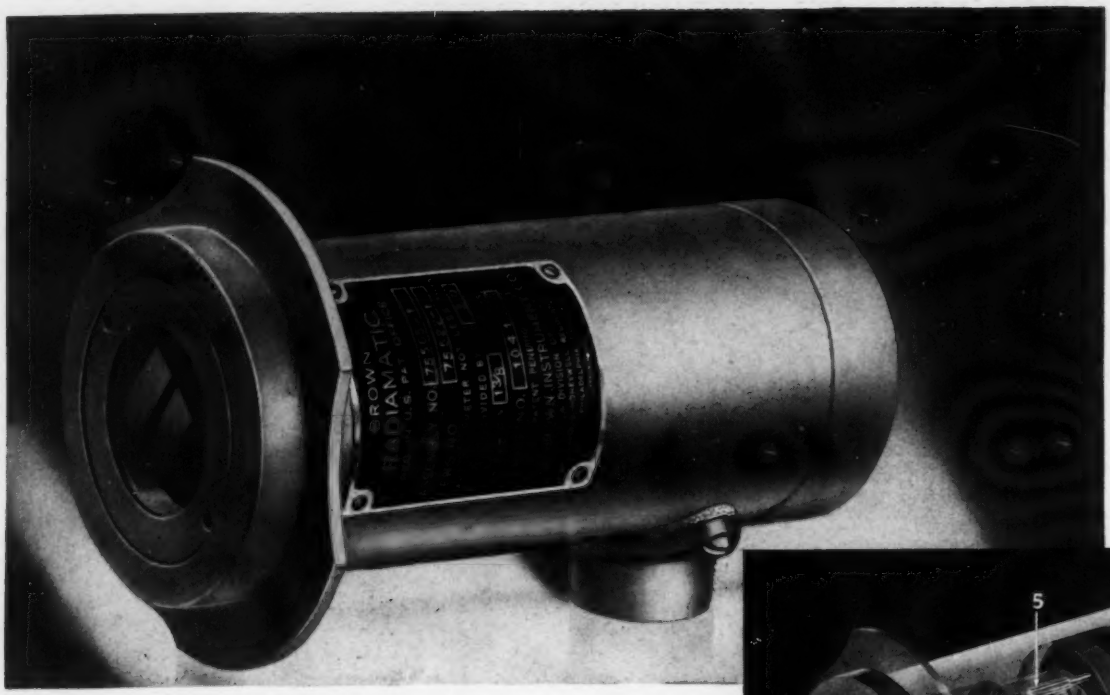

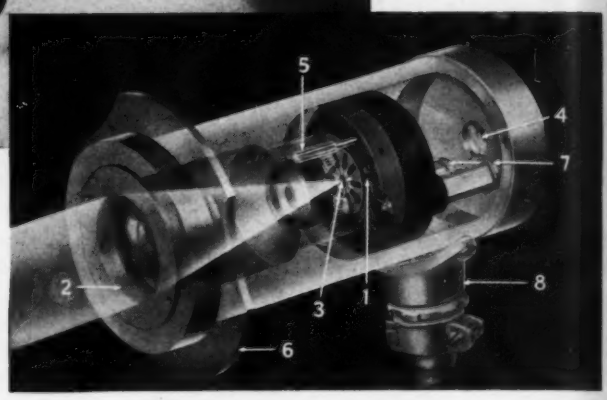

BROWN RADIAMATIC

Provides these advantages in measurement of temperature from 1000° F to 3500° F

Unaffected by Ambient Temperature changes.
Standardized Calibration — as interchangeable as thermocouples.
Eliminates water jacketed construction.
Fastest Response to all temperature changes.
Protected against contaminating dirt and gases.
Product Temperatures may be measured from a distance.
Accessory Fittings of sealed construction for all applications.

Thousands of installations in leading industries have proven Brown Radiamatics to be outstandingly rugged, accurate, dependable and economical in the measurement and control of critical temperatures. The Brown ElectroniK-Radiamatic system is applied to the operation of open hearths, soaking pits, blast furnaces, reheating furnaces and checker chambers of leading steel mills.

Write for Catalog 5102. THE BROWN INSTRUMENT COMPANY, a division of the Minneapolis-Honeywell Regulator Company, 4464 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. 119 Peter Street, Toronto, Canada; Wadsworth Road, Perivale, Middlesex, England; Nybrokajen 7, Stockholm, Sweden.

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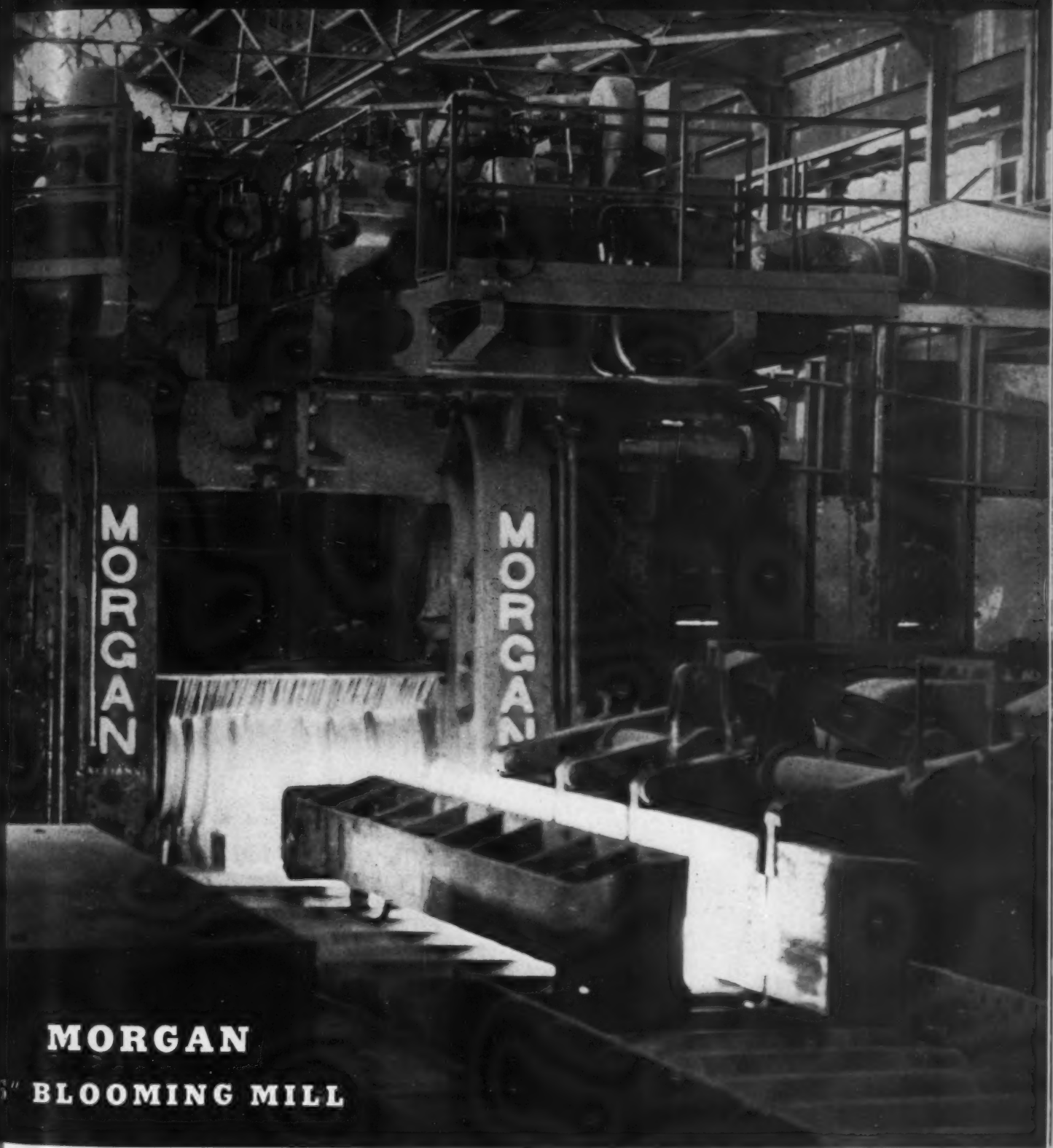
ElectroniK Recording Potentiometer

BROWN ElectroniK POTENTIOMETERS

BUILT BY MORGAN *Engineering*



MORGAN
35" BLOOMING MILL

ABOVE is shown a Morgan 35" two-high blooming mill complete with double manipulator, front and rear tables. A hydraulic roll changing device is provided. Housings are one-piece steel castings of the closed top type. Top roll balance is of the counterweight type. Manipulator is of the overhead type, compact and accessible. Tables are of heavy design, equipped with anti-friction bearings. Screw-down drive is arranged to provide crane hook access when changing guides. Provision is made for automatic lubrication and exclusion of scale and dirt.

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BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS
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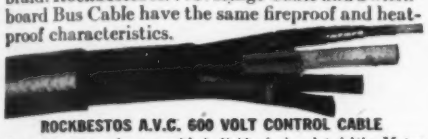
For Severe Conditions

Permanently Insulated ROCKBESTOS Wires, Cables and Cords

ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(National Electrical Code, Type AVB)

Sizes No. 18 to No. 4/0 AWG with varnished cambric and impregnated asbestos insulation and gray, black, white or colored flameproof braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

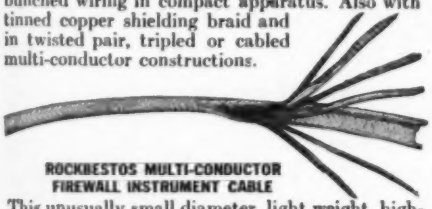
In one to 19 conductors with individuals insulated like Motor Lead Cable, cotton braid covered and cabled with an asbestos braid over all. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes manufactured for use in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

ROCKBESTOS FIREWALL RADIO HOOKUP WIRE

Sizes No. 22 to 4 AWG in 1000 volt rating, and No. 12, 14 and 16 AWG in 3000 volt insulated with high dielectric synthetic tape, impregnated felted asbestos and covered with color coded lacquered glass braid.

The first small diameter heat and flame resistant high-dielectric hookup wire, designed in 1937 and approved by the C.A.A. for use in airborne radio equipment. Widely used since in automotive and ground communications systems, electronic devices and apparatus. Operating temperature range 125° C. to minus 50° C. Ideal for small motor, coil, transformer and dynamotor leads and bunched wiring in compact apparatus. Also with tinned copper shielding braid and in twisted pair, tripled or cabled multi-conductor constructions.



ROCKBESTOS MULTI-CONDUCTOR FIREWALL INSTRUMENT CABLE

This unusually small diameter, light weight, high-dielectric 3 conductor No. 26 AWG cable, with individuals insulated like our Radio Hookup Wire, was designed for an electronic device in which three No. 22 AWG single conductor aircraft wires proved too bulky. It is made to a nominal diameter of .125" (smaller than a 14 AWG single conductor 1000 volt Rockbestos Firewall Radio Hookup Wire). Also in 4 and 5 conductor constructions.

ROCKBESTOS THERMOSTAT CONTROL WIRE

Sizes No. 14, 16 and 18 AWG in two to six conductors with .0125", or .025" or (for 115 volt service) .031" of impregnated felted asbestos insulation and steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal, and temperature control systems. Lifetime heatproof, fireproof insulation and rugged steel armor give troubleproof circuits.

ROCKBESTOS ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of Rockbestos A.V.C. Motor Lead Cable will complete the failure-proofing.

ROCKBESTOS APPARATUS HEATING CABLE

No. 19 AWG nickel-chromium resistance wire insulated with .040" of impregnated felted asbestos and covered with 4/64" waterproof lead sheath.

Manufacturers of photographic developing tanks, dry print developing machines, candy making equipment, soil heating cable kits and other devices requiring controlled distribution of mild heat can use this pliable heating cable to advantage. Also useful in preventing freezing of water pipes and congealing of oil, grease, ink, paint and sluggish fluids in conveyor pipes.

ROCKBESTOS 300 VOLT HEAT RESISTING FIXTURE WIRE
(Underwriters' Type AF)

Sizes No. 10 to 18 AWG stranded plain copper conductor insulated with black or white impregnated felted asbestos—with or without braid.

Rockbestos asbestos insulated fixture wires, approved by the Underwriters' Laboratories, are ideal for lighting fixture wiring because their heat resistant insulation will not bake out under the high socket temperatures developed in modern fixtures. Also used for small motor leads, miniature switchboards, business machines, radios, etc.

ROCKBESTOS ALL-ASBESTOS APPLIANCE LEAD WIRE

Sizes No 8 to 20 AWG solid or stranded copper, monel or nickel conductors insulated with .031" or .040" of impregnated felted asbestos in black, white or colors.

Whether you make waffle irons, hot-plates, small motors, ranges, water heaters, radios, ovens or blueprint machines, we can give you an asbestos lead wire made to fit the electrical and mechanical requirements of your product.

ROCKBESTOS ALL-ASBESTOS 600 VOLT FLEXIBLE CORD

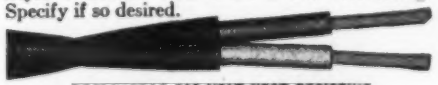
Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos and covered with a heavy asbestos braid.

This heavy duty heat-resisting flexible cord is ideal for high wattage lighting units, apparatus, floodlights, etc., that are used in hot spots or develop heat in operation. For moisture resistant type specify the Rockbestos A.V.C. construction described below.

ROCKBESTOS A.V.C. 600 VOLT FLEXIBLE CORD

Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos, varnished cambric, felted asbestos and covered with a heavy impregnated asbestos braid.

For applications such as mentioned above in which heavy duty, high-dielectric, heat and moisture resistant flexible cord is required we recommend this construction with individual conductors insulated exactly like Rockbestos A.V.C. Motor Lead Cable. Approved for lighting applications, with polarized conductors, by Underwriters' as Style V flexible cord under a 300 volt rating. Specify if so desired.



ROCKBESTOS 300 VOLT HEAT RESISTING DUPLEX FLEXIBLE CORD
(Underwriters' Type AFPD)

Sizes No. 10 to 18 AWG stranded plain copper conductors insulated with impregnated felted asbestos, polarized, twisted together and covered with a cotton braid.

This duplex heat resisting flexible cord is approved by the Underwriters' Laboratories for use in fixtures and is recommended for pendant types as the asbestos insulation will not dry out or crack at the socket. It provides protection against wire-failure, eliminates fire-hazard and gives permanent suspension as it does not deteriorate with heat or age. Also in twisted pair, tripled and triplex.

ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(National Electrical Code, Type AVA)

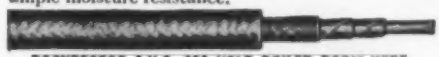
Size No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated asbestos and a high-dielectric varnished cambric insert, with a heavy asbestos braid overall.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA)

Sizes No. 18 AWG to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid Other constructions for service voltages to 5000.

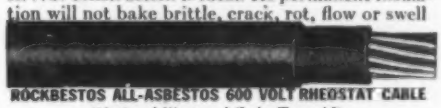
Use Rockbestos A.V.C Power Cable for the internal wiring and power leads of heat-exposed heavy electrical equipment and hot-spot wiring in conduit around boiler rooms, steam lines, furnaces, etc., as it withstands high temperatures and has ample moisture resistance.



ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell



ROCKBESTOS ALL-ASBESTOS 600 VOLT RHEOSTAT CABLE
(National Electrical Code, Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For flexible stranded conductor specify Rockbestos All-Asbestos Flexible Apparatus Cable. For solid conductor specify Rockbestos All-Asbestos Rheostat Wire.

A few of the National Electrical Code types (listed by Underwriters' Laboratories) and other constructions in the Rockbestos line of 125 different *permanently insulated* wires, cables and cords designed to give long-lived, dependable service in electrical products — all built to resist such wire-destroying hazards as heat, moisture, oil, grease, corrosive fumes and flame. For complete information or samples write to:

Rockbestos Products Corporation
101 Nicoll St., New Haven 4, Conn.

RESIST Heat, Moisture, Oil, Grease And Fumes WON'T Bake Brittle, Bloom, Burn or Rot

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In Steel Gears and Castings

NE . . . is maintaining the leadership in war-time Service of Supply which it achieved in serving a peace time Industrial Nation with Neloy and Neloy Molybdenum Steel Gears and Castings. War-time production comes first on any schedule ... however, sufficient capacity in plant and equipment is available for producing maintenance parts important to the smooth running of Industry's heavy schedules today . . . the National Erie Corporation producing to specifications for Uncle Sam, stands ready to do its utmost to supply necessary maintenance parts for heavy machinery... Iron and Steel Engineers can depend upon our earnest efforts to serve them as promptly as possible for the Duration.

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ERIE, PENNSYLVANIA • U. S. A.

See SPEER for...

. . . steps up performance of motors and generators

Watch d-c and slip-ring motors and generators *pep up* when the Matched Commutation of SPEER Brushes gets on the job.

Matched Commutation—the matching of brushes, mechanically and electrically, to the service characteristics of the machines they're sold to serve—has been a SPEER specialty for almost 50 years. That's why SPEER brushes give you utmost freedom from burning, sparking, overheating, excessive wear and energy losses, and other brush troubles that decrease operating efficiency, cause extra maintenance.

Save time. Avoid the possibility of brush "misfits." From its all-inclusive line of standard and special carbon, graphite, electro-graphite, and metal-graphite brushes, SPEER can supply the grade that will deliver peak performance, with fewer brush renewals and less maintenance, on any commutating equipment.

So for brushes matched to *your* machines, call on SPEER—write for Brush Data Forms.

CHICAGO • CLEVELAND • DETROIT
MILWAUKEE • NEW YORK • PITTSBURGH

SPEER
CARBON COMPANY
ST. MARY'S, PA.

B166

Waste Acid NEUTRALIZATION

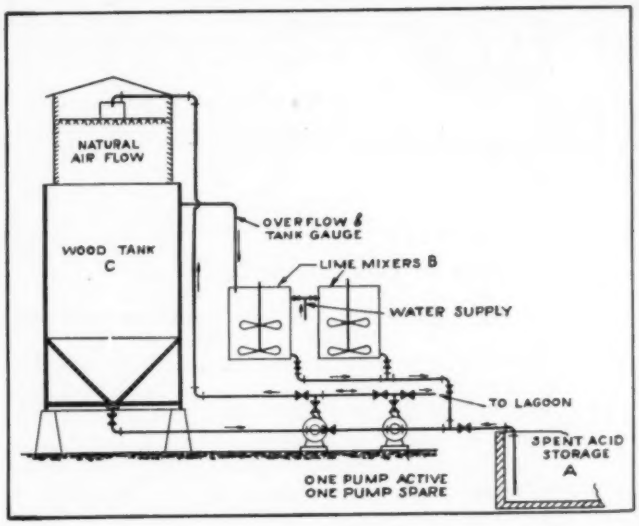
The Heart of the System. Self-priming Durcopump with transfer lines and Duriron valves all handling waste acid, milk of lime and neutralized waste. Note milk of lime tank at left; neutralization tank at upper left.

Photos by courtesy of Mercer Tube & Mfg. Co, Sharon, Pa.

Disposal basin where neutralized waste is settled. Harmless effluent overflows to sewer.

Note the simplicity of this modern and efficient milk of lime — sulphuric acid neutralizing system. But one Durcopump handles the milk of lime and the waste pickling acid from the collection sump to the neutralizing tank. After complete neutralization, the same pump discharges the tank to the settling basin. It is as simple as that!

Let us help you plan your disposal system with Duriron and Durimet equipment. Both alloys are "naturals" for acid disposal work. Call in the Duriron engineer today.



Spent acid is drawn from tank A through pump and milk of lime is added as mixture is pumped into tank C until overflow or tank gauge registers full; then milk of lime and spent acid valves are closed and circulating valves are opened and pump circulates the mixture through tank to aerate. The mixture is then pumped to lagoon for settling.

ARMY E NAVY
DURIRON · DURICHLOR
CORROSION-RESISTING
DURCO
ALLOYS & EQUIPMENT
THE DURIRON CO. INC. DAYTON, OHIO
DURIMET · DURCO STAINLESS STEELS
THE DURIRON COMPANY, Inc. DAYTON, OHIO

MORE than five times the size of an ordinary fire brick, yet it weighs practically the same! That in a few words tells the story behind the installation economies of J-M Insulating Fireblok.

Lightness speeds work—You can see immediately what the light weight of these large-size units means in terms of labor economy . . . speedier installation.

Easily cut and fitted—J-M Insulating Fireblok can be cut with a saw, shaped with a rasp, or drilled . . . and easily fitted into irregular positions. Makes a large stock of special shapes unnecessary.

Minimum of joints—The large size of J-M Insulating Fireblok so reduces the number of joints as to materially improve the thermal efficiency of the construction.

Economical bonding — Naturally, this reduction in joint length speeds work and reduces the amount of cement needed for bonding. (J-M 1626 cement was developed especially for this use.)

Uses—Use Fireblok w here Insulating Fire Brick is recommended—industrial furnaces, flues, etc. It is particularly suitable for door linings, suspended arches, and when tapered, for sprung arches of exceptional stability.

For specific temperature ranges—These block-shaped, workable insulating refractory linings come in 4 different types—the same as J-M Insulating Fire Brick. Each type was especially developed for its particular temperature range.

Fireblok is only one of many J-M Insulations for industrial use. Johns-Manville Insulations cover the full temperature range from 400° F below zero to 2600° F above. J-M's long experience and research assure you authoritative help in your insulation planning. For further information, write Johns-Manville, 22 E. 40th St., New York 16, N. Y.

Over 5 times as large as ordinary fire brick, Fireblok goes into place quickly and economically. Not only is labor time saved, but costly shut-down time is decreased.

4 Fireblok types available

JM-1620 Fireblok for exposed temp. to 1600° F. As back-up to 2000° F.

JM-20 Fireblok for use up to 2000° F. Exposed or back-up.

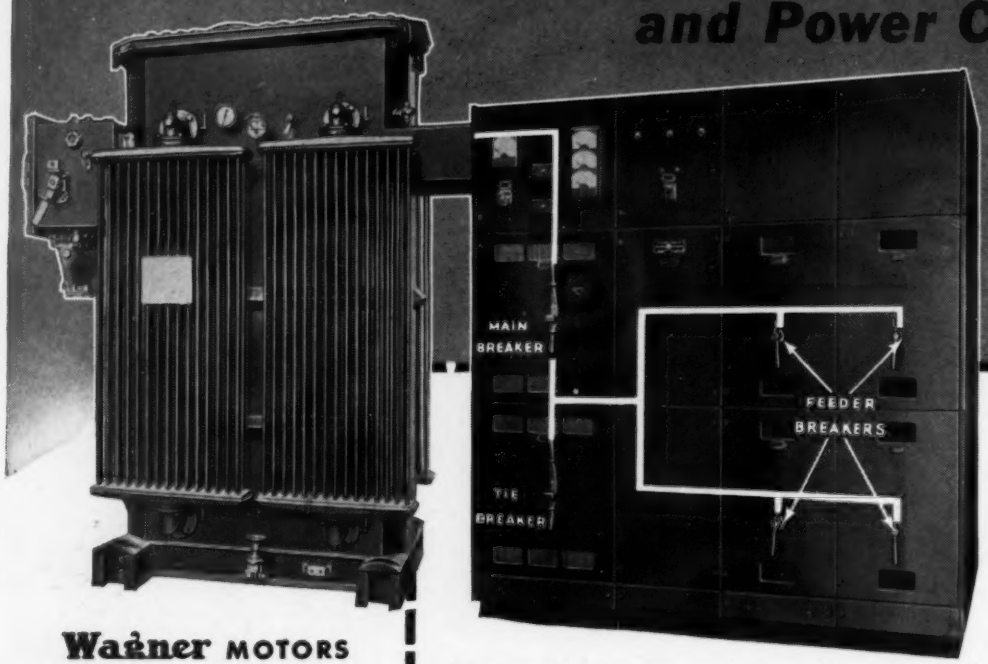
JM-23 Fireblok for use up to 2300° F. Exposed or back-up.

JM-26 Fireblok for use up to 2600° F. Exposed or back-up.

JOHNS-MANVILLE *First in* **INSULATIONS**

Wagner
UNIT SUBSTATIONS

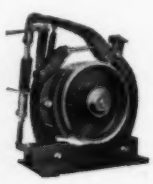
Provide Load Center Control for Lighting and Power Circuits...



Wagner MOTORS

There is a Wagner motor to fit every job. Our line is complete from small fractional-horsepower fan-type motors to large 400-horsepower motors used in heavy industries.

Wagner INDUSTRIAL HYDRAULIC BRAKES



Wagner Industrial Hydraulic Brakes are of two types: without parking brake (Type H) and with parking brake (Type HM). These braking systems provide quick, safe, smooth stops with the operator in complete and accurate control.

THESE BRANCHES ARE READY TO SERVE YOU

ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT HOUSTON • INDIANAPOLIS • KANSAS CITY LOS ANGELES • MEMPHIS • MILWAUKEE MINNEAPOLIS • NEW YORK • OMAHA PHILADELPHIA • PITTSBURGH • PORTLAND ST. LOUIS • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • SYRACUSE • TULSA WASHINGTON, D. C.

Each of these offices is manned by trained field engineers. They will gladly consult with you regarding your transformer, motor, and brake requirements.

Check THESE ADVANTAGES

Wagner unit substations can be located any place inside or outside your plant thus making it possible for you to determine the location of the load center placing it near the heavy load areas or power-using centers. Wagner unit substations combine one or more step-down transformers with the necessary load center for controlling the distribution power-circuits.

1. Saving of copper in connecting cables. Locating the transformer near the load allows the use of shorter and smaller cables over a great part of the distance the power must travel.

2. Improves performance of motors and lights. Inherent linedrop is avoided by eliminating long low-voltage feeders.

3. Can be installed indoors without the use of extensive fireproof vaults. The entire substation may be located on the floor in the open, saving construction time and material.

4. Simplifies installation. Complete substation is shipped in one or more factory-assembled units, completely wired, ready for installation and final connection.

5. Provides flexibility to meet future conditions. Compartments in the load centers are of such dimensions that interchangeable breakers of different interrupting ratings can be substituted should plant modifications bring about changes in feeder loads.

6. Low maintenance expense. The complete enclosing of the buses and other equipment practically eliminates cleaning and dust problems and assures safety against contact with live parts.

Illustrated above is a 1000-kva, 13,200-to 480-volt, 3-phase transformer with a two-position liquid-filled disconnecting switch on high-voltage side, key-interlocked with low-voltage breaker. The low-voltage side is equipped with air-break circuit-breakers manually operated, ground-indication lights, voltmeters, ammeters, ammeter switch, and test-blocks. Unit has one main breaker, one tie breaker, and four feeder breakers.

T45-17

Wagner Electric Corporation

ESTABLISHED 1891

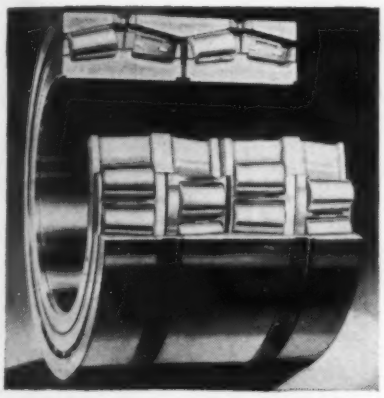
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

In Canada: Wagner Electric at Leaside, Ontario

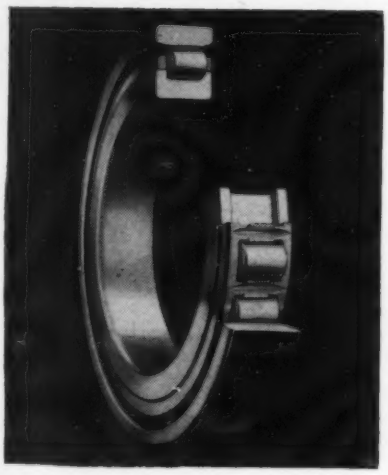
ELECTRICAL AND AUTOMOTIVE PRODUCTS

FOR MORE OUTPUT, LESS MAINTENANCE
SPECIFY TORRINGTON BEARINGS

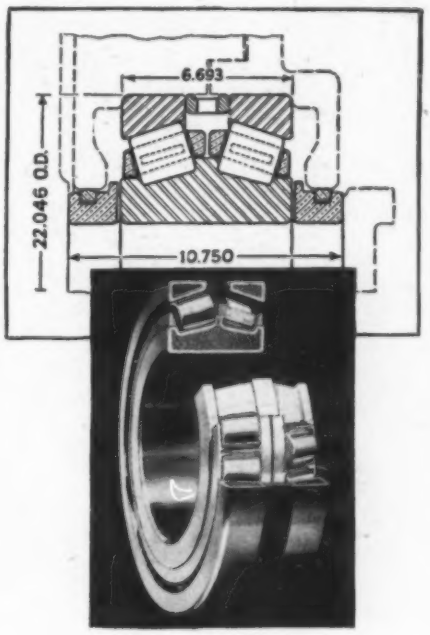
With the trend in steel mills toward speedier production at lower cost, comes the demand for equipment that "rolls it out" faster with fewer and shorter shutdowns for maintenance. Shown on this page are some typical steel mill applications of Torrington Bearings. Designing and building to specific requirements has for years been a function of Torrington's Bantam Bearings Division. Our engineers will gladly help yours to incorporate Torrington Bearing advantages into your present or future designs.



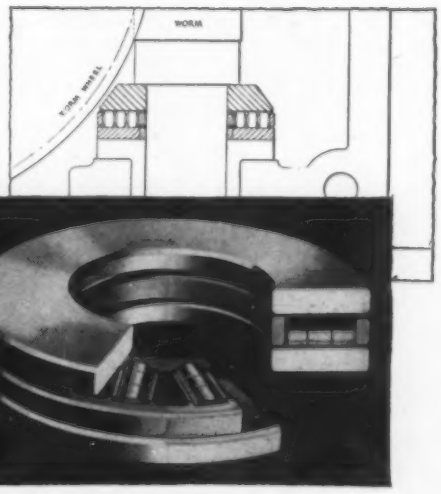
⬅⬅ HIGHER ROLL NECK SPEEDS
and maximum service life are attained by use of Torrington Tapered Roller Bearings. Four-row taper type bearing shown here is used on the roll necks of Mesta five-stand mill delivering 3200 feet of cold strip per minute. Bore is 12 inches; O.D. is 17¼ inches. These bearings handle loads efficiently, assure long and trouble-free service life.



PEAK TONNAGE RECORDS ➡➡
come easier when Torrington Two-Row Tapered Roller Bearings made of S.A.E.-3310 steel (with higher nickel content) carry the thrust loads imposed on back-up rolls. Bearing shown here, designed for 80" four-high continuous hot strip mill, has thrust load capacity of 220,900 pounds at 100 r.p.m. Features include simplicity of design for positioning in housing; controlled lubrication; clearance adjustment to permit assembly as received; and take up as required, with spacer width control.



⬅⬅ MORE ACCURACY
is attained when Torrington Radial Roller Bearings are used in flying shears. Bearing shown here is built to take the around-the-clock punishment imposed by high speed operation of a modern strip steel cutter and to provide the necessary accuracy in shearing so that edges are clean and lengths are cut within specified tolerances.

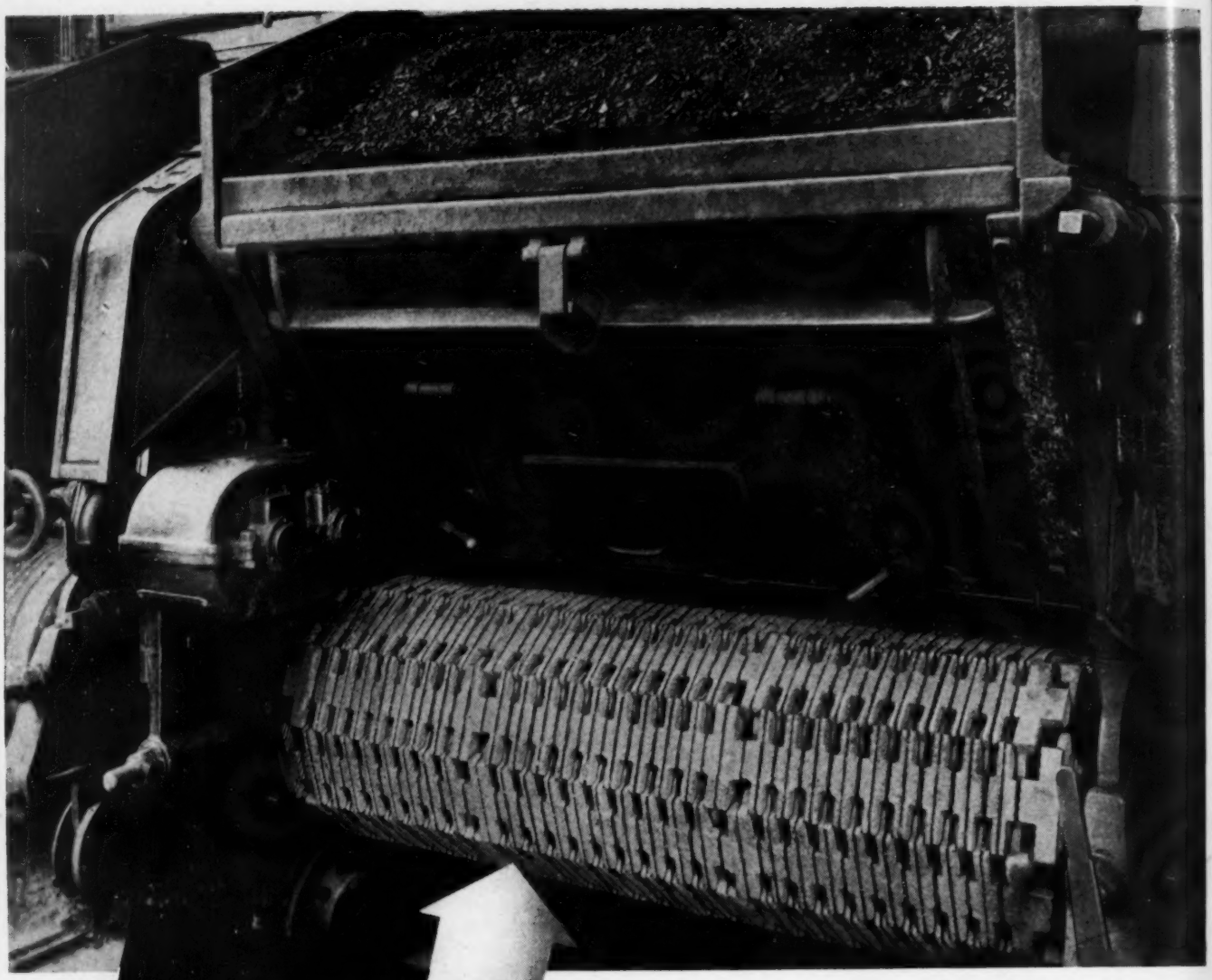


LESS MAINTENANCE ATTENTION ➡➡
is needed when screw downs turn on Torrington Roller Thrust Bearings. Bearing shown here is used on four-high screw downs. Specifically designed to handle tremendous loads at high speeds, it helps the mill deliver more work for less power...stay on the job longer with less interruption...give more years of dependable, trouble-free service.

THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

TORRINGTON BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL



● Nickel chromium cast iron chain grate in operation at the power house of a prominent Canadian brewery.

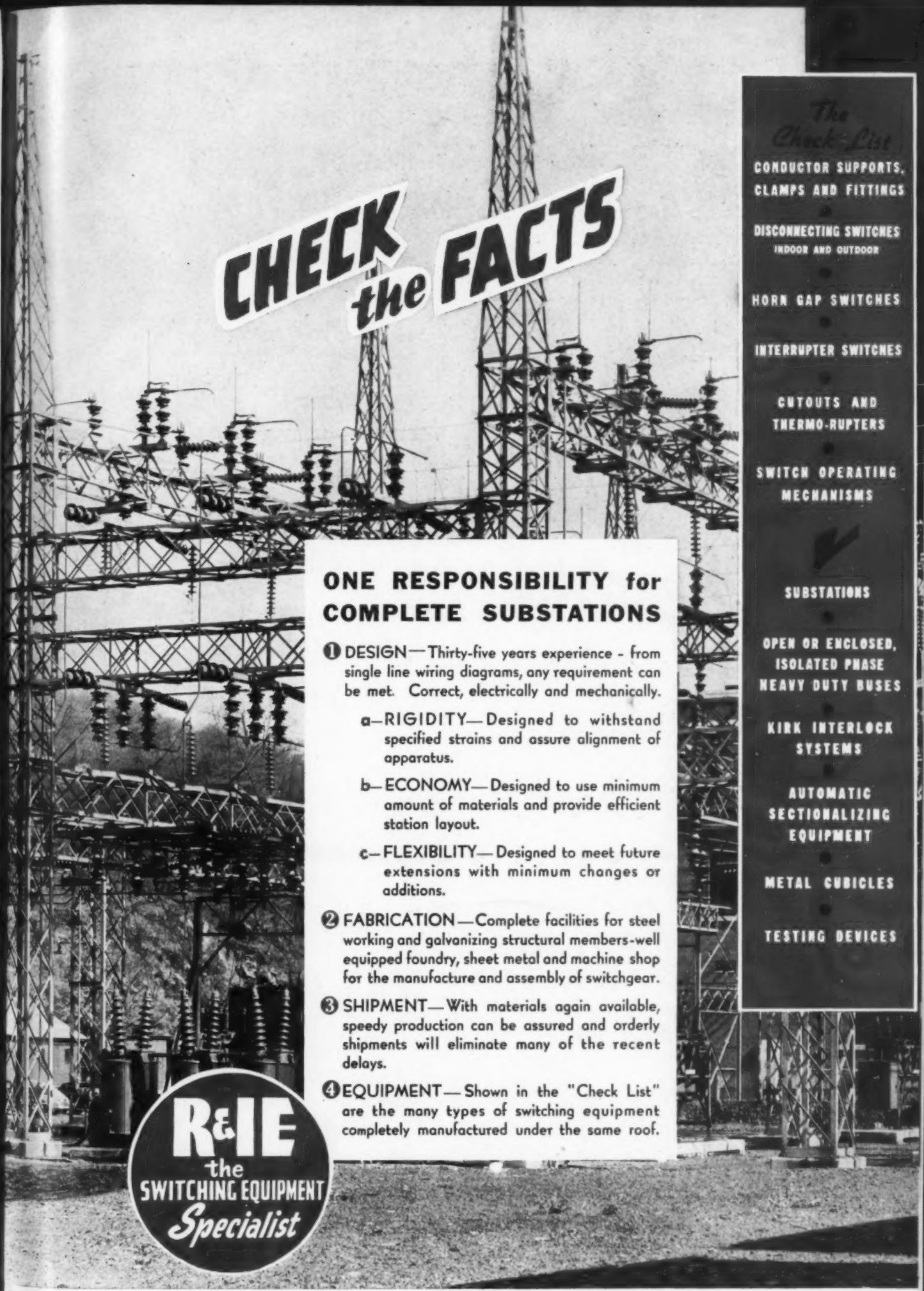
4 TIMES THE LIFE

OF PLAIN CAST IRON, WHEN MADE OF

Nickel chromium CAST IRON

FOR COMPLETE DETAILS WRITE TO:

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.



CHECK the FACTS

ONE RESPONSIBILITY for COMPLETE SUBSTATIONS

1. DESIGN — Thirty-five years experience - from single line wiring diagrams, any requirement can be met. Correct, electrically and mechanically.
   - a — RIGIDITY — Designed to withstand specified strains and assure alignment of apparatus.
   - b — ECONOMY — Designed to use minimum amount of materials and provide efficient station layout.
   - c — FLEXIBILITY — Designed to meet future extensions with minimum changes or additions.
2. FABRICATION — Complete facilities for steel working and galvanizing structural members-well equipped foundry, sheet metal and machine shop for the manufacture and assembly of switchgear.
3. SHIPMENT — With materials again available, speedy production can be assured and orderly shipments will eliminate many of the recent delays.
4. EQUIPMENT — Shown in the "Check List" are the many types of switching equipment completely manufactured under the same roof.

The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

R&IE the SWITCHING EQUIPMENT *Specialist*

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

BRANCH IN CANADA — EASTERN POWER DEVICES, LIMITED, TORONTO

BLAST FURNACES

1. BLOWER CONTROL
   - (a) Volume basis
   - (b) Constant weight basis
2. GAS BLEED CONTROL
3. BLAST FURNACE STOVE CONTROL
   - (a) Gas input
   - (b) Gas-air ratio
   - (c) Stove dome temperature

COKE OVENS

1. EXHAUSTER CONTROLS
2. COLLECTING MAIN PRESSURE REGULATORS
3. STACK DRAFT CONTROL
4. UNDERFIRING GAS PRESSURE REGULATORS

BESSEMER

1. AIR FLOW OR AIR PRESSURE CONTROL

OPEN HEARTH

1. HEAT INPUT CONTROL
2. ROOF TEMPERATURE CONTROL
3. FURNACE PRESSURE CONTROL
4. FUEL-AIR RATIO CONTROL
   - (a) Oil firing
   - (b) Gas firing
5. REVERSAL CONTROL

Controls by

HAGAN

everywhere in the

STEEL INDUSTRY

SOAKING PITS

1. TEMPERATURE CONTROL
2. FUEL-AIR RATIO CONTROL
   - (a) Oil firing
   - (b) Gas firing
3. FURNACE PRESSURE CONTROL
4. GAS PRESSURE CONTROL

HEATING FURNACES

1. HEAT INPUT CONTROL
2. FUEL-AIR RATIO CONTROL
   - (a) Oil firing
   - (b) Gas firing
3. FURNACE PRESSURE CONTROL
4. GAS PRESSURE CONTROL

BOILER HOUSES

1. STEAM PRESSURE REGULATION
2. LOAD DISTRIBUTION CONTROL
3. FUEL-AIR RATIO CONTROL
4. FURNACE DRAFT REGULATION
5. AUTOMATIC FUEL MAKE-UP CONTROL

GAS DISTRIBUTION SYSTEMS

1. GAS PRESSURE REGULATIONS
2. MIXING STATIONS
3. SEQUENTIAL DISTRIBUTION CONTROL
4. PRESSURE STABILIZATION CONTROL
5. BLEED CONTROL

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Hagan Building • Pittsburgh 30, Pa.

HAGAN HALL BUROMIN CALGON

HAGAN *Automatic* COMBUSTION CONTROL

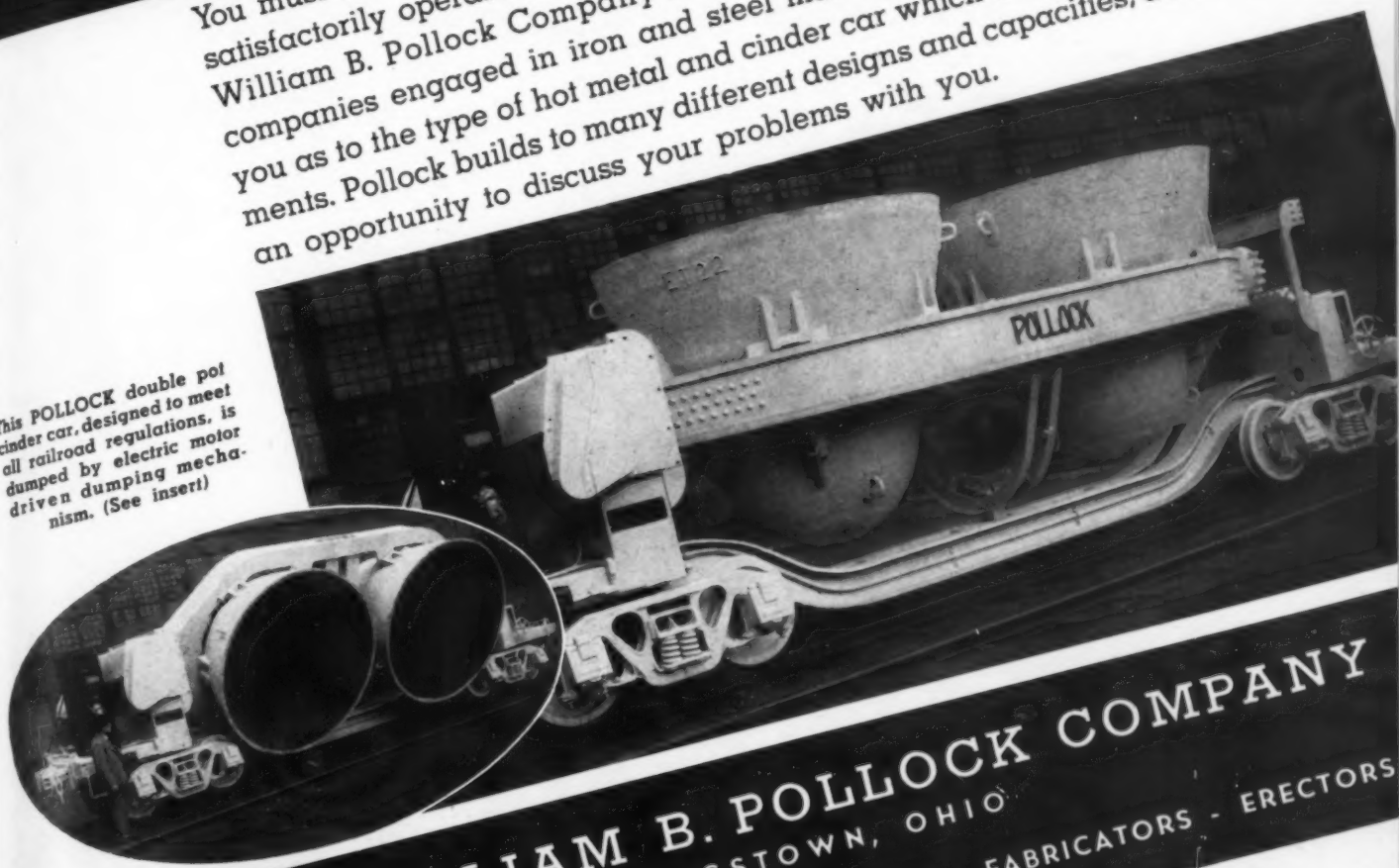
The pioneer . . . and still the leader

POLLOCK heat retaining ladles can be lifted from the car and poured directly into the mixer—or dumped in the car itself. (See insert)

POLLOCK

HOT METAL CARS & CINDER CARS

You must have up to date Hot Metal and Cinder handling equipment to satisfactorily operate Modern Blast Furnaces and Steel Plants. Because The William B. Pollock Company has had many years experience in serving companies engaged in iron and steel making, it is qualified to advise with you as to the type of hot metal and cinder car which best meets your requirements. Pollock builds to many different designs and capacities, and welcomes an opportunity to discuss your problems with you.



This POLLOCK double pot cinder car, designed to meet all railroad regulations, is dumped by electric motor driven dumping mechanism. (See insert)

The WILLIAM B. POLLOCK COMPANY

YOUNGSTOWN, OHIO

STEEL PLATE CONSTRUCTION • ENGINEERS - FABRICATORS - ERECTORS

BLAST FURNACES • HOT METAL CARS & LADLES • INGOT MOULD CARS
CINDER AND SLAG CARS • CHARGING BOX CARS
WELDED OPEN HEARTH LADLES
WELDED STEEL PRODUCTS

ROLLING TECHNIQUE . . .

BLOOMING MILL ROLLS

MODERN blooming mills are usually of the two-high reversing type. The rolls may be as large as 54" but average about 40". PITTSBURGH ROLLS for the blooming mill, whether of plain carbon steel for extreme strength, or of Phoenix "A" Alloy Steel where unusual wearing qualities are desired, will produce blooms, billets, and slabs at LESS COST PER TON OF STEEL ROLLED.

PITTSBURGH ROLLS
Division of Blaw-Knox Company
PITTSBURGH, PA.

The illustrations show how the cross section of the piece changes as it passes from ingot to billet.

PITTSBURGH ROLLS

Now more than ever—you need Mill Economies that

Industrial LOGISTICS*

can help you effect

**The science of transporting Steel Plant Loads in Master Units, through every Mill Process, on Elwell-Parker Systems of Electric Trucks, Tractors and Cranes — to insure Faster Production, Greater Turnover, Increased Safety and New Low Costs.*

YOU are *practicing* Industrial Logistics, every time you effect a saving in load-transportation that contributes to greater volume, at lower prices.

You are *following through* on Industrial Logistics, every time you find a new place in your Mill

—where *loads* can be doubled or tripled without doubling or tripling costs;

—where *minutes* can be cut from time required to transport those loads;

—where *men* can be given still more protection through elimination of accident hazards.

The Elwell-Parker Steel-Handling Specialist has successful experience and ideas you can use in effecting lower costs for the competitive days ahead.

The Elwell-Parker Electric Company, 4504 St. Clair Avenue, Cleveland 14, O.

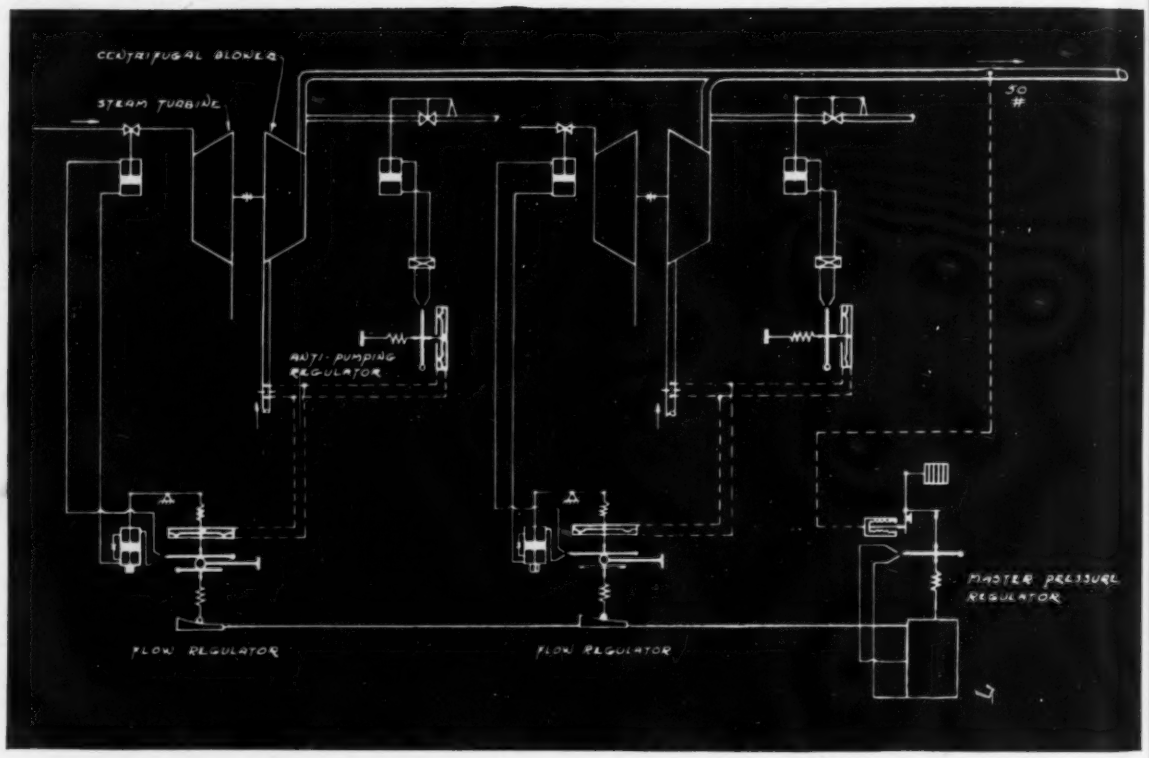
ELWELL-PARKER

POWER INDUSTRIAL TRUCKS

Established 1893

"Hunting" is Fun...

...BUT NOT IN TURBO-BLOWER Control



Of all the various control applications a Turbo-Blower installation emphasizes the advantanges of Askania's Jet-Pipe regulator.

Because of the rapid and extreme load changes, only a controller of speed, sensitivity and stability can do the job.

The Askania Regulator is engineered to provide closely held control, guard against pumping and permit parallel operation when desired. With its Hydraulic Stabilizer this Askania Regulator has proved its ability in eliminating "droop", over regulation and "hunting".

The above photo shows the I-R Turbo-Blower installation at the Kaiser-Fontana plant.

ASKANIA REGULATOR CO.
A GENERAL PRECISION EQUIPMENT CORPORATION SUBSIDIARY
1601 S. MICHIGAN AVENUE, CHICAGO 16, ILLINOIS

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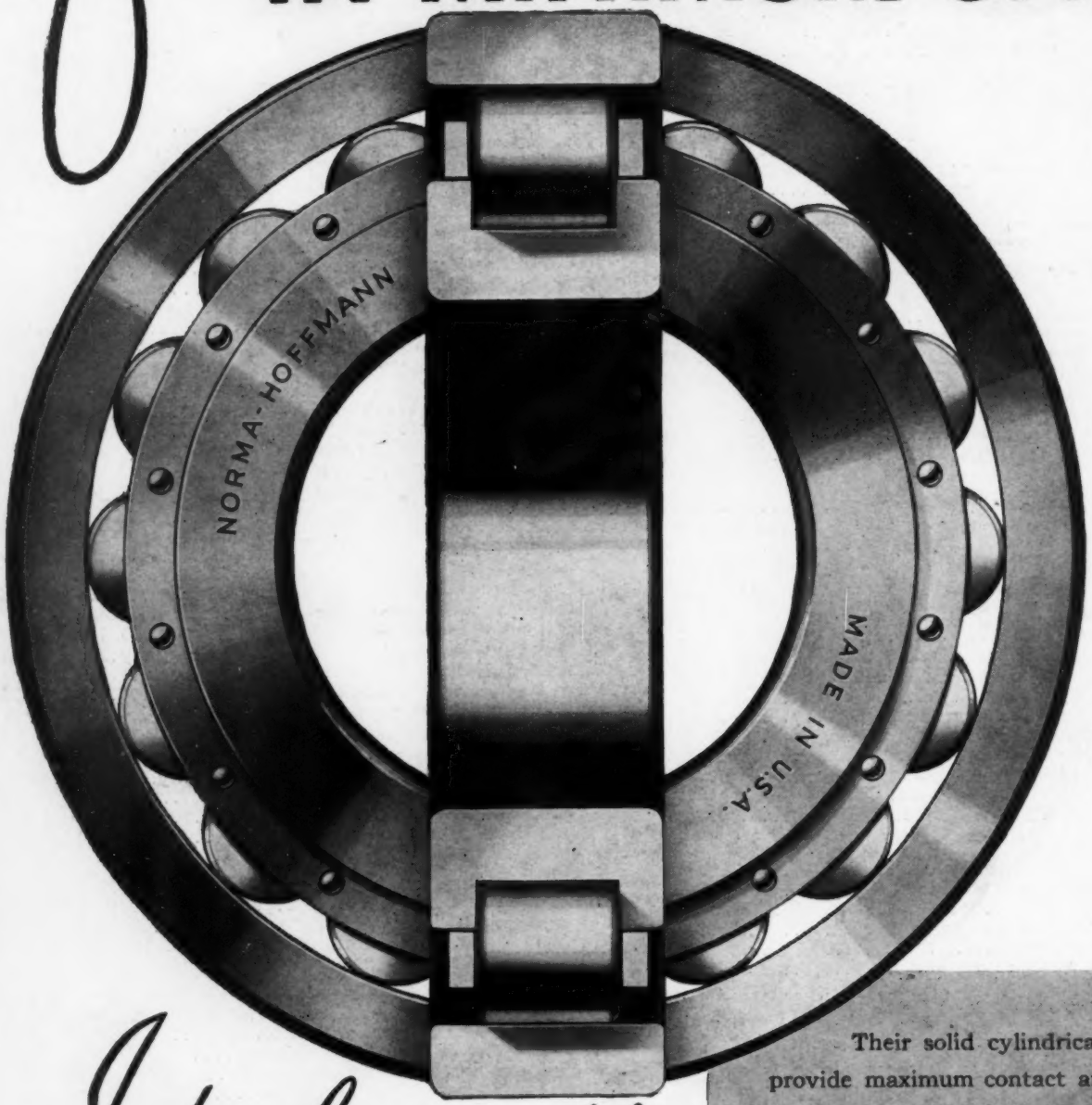
for MAXIMUM CAPACITY IN MINIMUM SPACE



Interchangeable

WITH SINGLE-ROW BALL BEARINGS

NORMA-HOFFMANN

PRECISION ROLLER BEARINGS

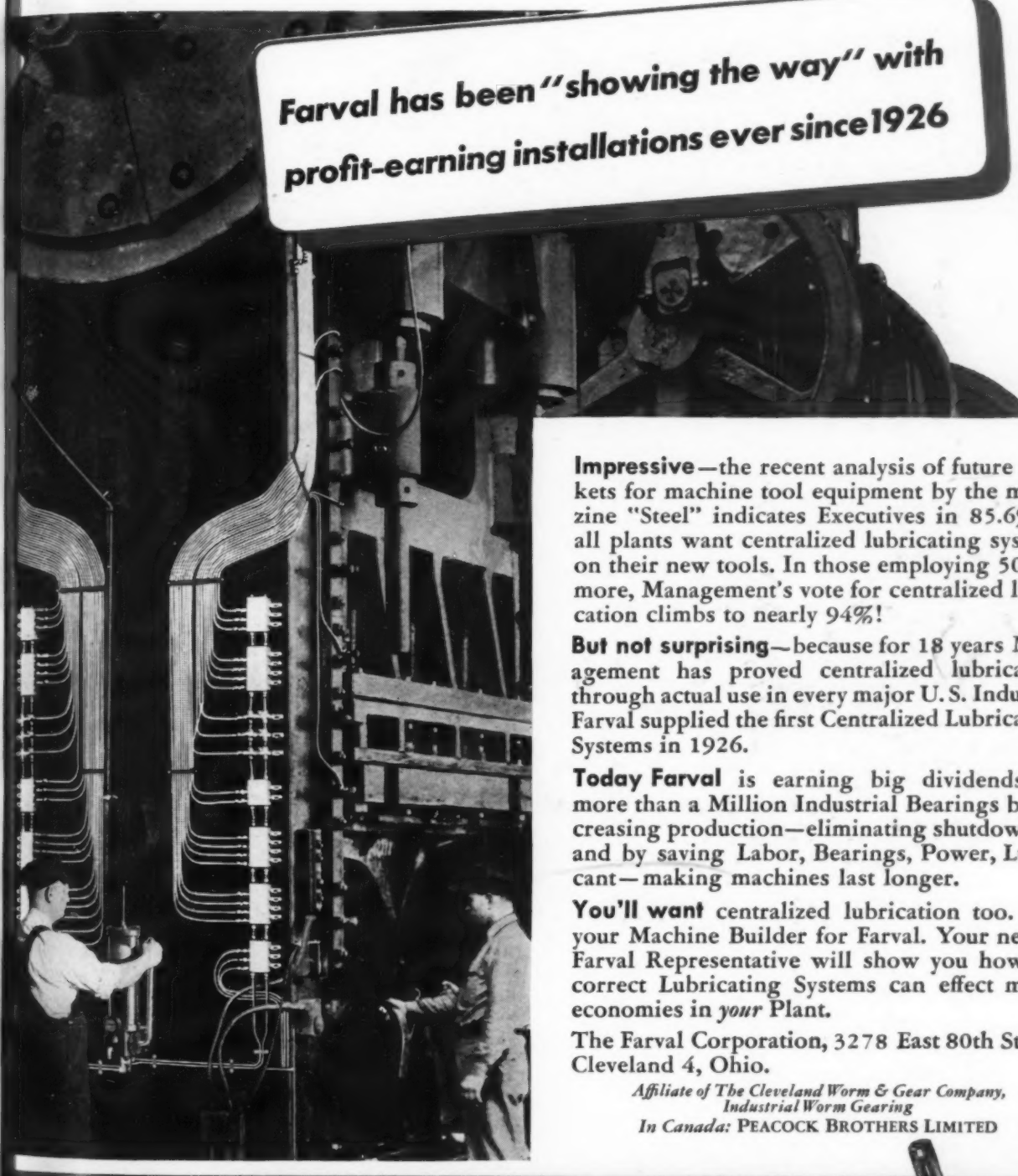
NORMA-HOFFMANN BEARINGS CORP'N.,

STAMFORD, CONN., U. S. A. • *Founded in 1911.*

Write for the Catalog. Let our engineers work with you.

Their solid cylindrical rollers provide maximum contact area, giving larger load and shock-absorbing capacity than any other single-row bearing of like dimensions. Thus, when NORMA-HOFFMANN PRECISION ROLLER BEARINGS are used in place of ball bearings, a greater factor of safety is provided, together with added life, particularly under vibration and overload. PRECISION qualities in workmanship and materials adapt them alike for both low and high speeds.

9 Out of Every 10 Executives want Centralized Lubrication Postwar



Impressive—the recent analysis of future markets for machine tool equipment by the magazine "Steel" indicates Executives in 85.6% of all plants want centralized lubricating systems on their new tools. In those employing 500 or more, Management's vote for centralized lubrication climbs to nearly 94%!

But not surprising—because for 18 years Management has proved centralized lubrication through actual use in every major U. S. Industry. Farval supplied the first Centralized Lubricating Systems in 1926.

Today Farval is earning big dividends on more than a Million Industrial Bearings by increasing production—eliminating shutdowns—and by saving Labor, Bearings, Power, Lubricant—making machines last longer.

You'll want centralized lubrication too. Ask your Machine Builder for Farval. Your nearby Farval Representative will show you how the correct Lubricating Systems can effect major economies in *your* Plant.

The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing

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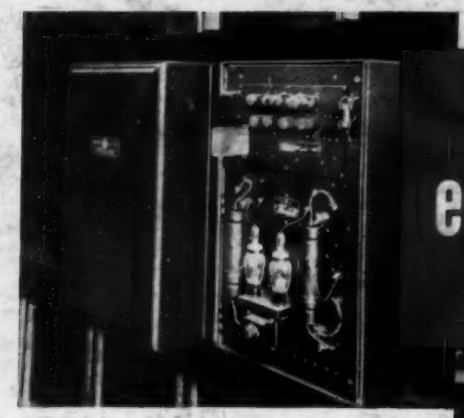

Two of the compact Thy-mo-trol electronic panels (one with cover removed) which rectify and control the power operating the reel motors.

electronic self-adjusting driv

...coils strip at constant tension

Thy-mo-trol d-c drive motors (400/1600 rp operate through speed reducers to provide required reel speed. Motor field-control au matically reduces speed as coil diameter bu up, holding tension constant.

At Allegheny-Ludlum Steel Corp., West Leechburg, Pa., smooth, constant-tension coil winding is now possible on the delivery reels of strip-annealing furnaces. The mechanical problems of slip-clutch operation have been eliminated. Full flexibility to handle strip speeds from 3 to 12 fpm is provided. The drive adjusts itself to the speed changes required to allow for coil build-up from 16 to 40 inches in diameter.

OPERATES FROM A-C POWER

Operated from an a-c power source, 2-hp Thy-mo-trol drives on these small reels give the same stepless speed control and torque control that is obtained with larger d-c adjustable voltage systems on mill drives. The operator sets a tension-adjusting rheostat at the desired value, and this level is held throughout the wind-up of the coil.

WIDELY APPLIED

This is only one of the increasing number of Thy-mo-trol applications throughout the steel industry, where stepless speed control, constant acceleration, or co speed under changing loads is required.

You buy Thy-mo-trol drive as a complete, co-ord set of equipment, including d-c motor, electronic transformer, and control station. *Standard* drives obtained from 1/8 to 25 hp. G-E engineers will he select and apply Thy-mo-trol drives, or explor suitability for new types of jobs. To read the full ask for Bulletin GEA-4025. *General Electric Co Schenectady 5, N. Y.*

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